Engineering

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ELECTRICAL WORLD

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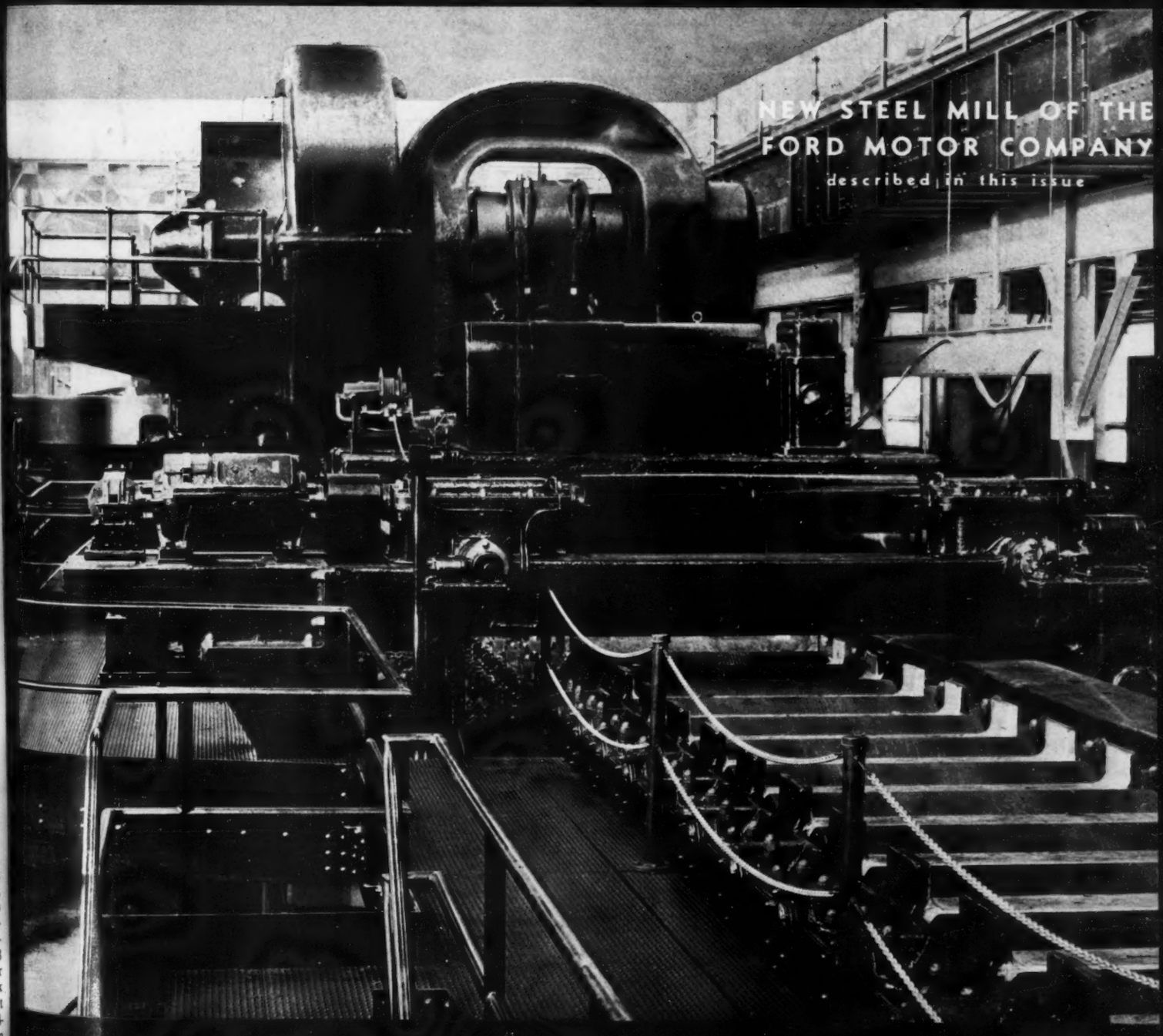

NEW STEEL MILL OF THE FORD MOTOR COMPANY described in this issue

With this issue, as a Supplement:

OPERATING STATISTICS OF 174 LARGE SYSTEMS

A Simple, Automatic

INDICATING ALARM

FOR SMOKE, FUMES, VAPORS

THE MODEL 708 INDICATING ALARM employs the life-time Weston *PHOTRONIC (photoelectric) Cell, and Weston relays. Cell and light source can be mounted wherever required. No amplification needed. Compact, easy to install.

*PHOTRONIC—*a registered trademark designating the photoelectric cells and photoelectric devices manufactured exclusively by The Weston Electrical Instrument Corporation.*

THE WESTON

*PHOTRONIC *(photoelectric)*

INDICATING ALARM

Cuts fuel costs . . . and solves many problems in processing

A LARGE UTILITY in a residential area found that smoke from the stacks was threatening company good-will throughout the community. Weston Indicating Alarms were installed, and the smoke nuisance banished. In addition, they now have a far more efficiently operated boiler plant.

A LARGE PROCESSING PLANT eliminated the fire hazard in drying fibre products, with the Weston Indicating Alarm. The presence of smoke in the air ducts leading from the large continuous dryers is immediately detected, and adequate warning provided.

A SMALL MANUFACTURER was forced to operate a few percent below the optimum level during night shifts as a safety factor against rapid soot formation. A Weston Indicating Alarm was installed, and the burners now are adjusted to give a peak CO_2 percentage.

Large plant or small, the Weston Indicating Alarm can cut costs and increase efficiency in the boiler room . . as a safety device . . . or in processes or equipment where it is essential to detect the presence or control the concentration of fumes or vapors. A bulletin is available, giving complete data. Write for your copy . . . Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark, N. J.

WESTON *Instruments*

Table I—Data on Output and Pe
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Public utility, lighting, power and electric railw

Line No.	Company or System*	1935			1934	
		System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*)	Output for Year (Including Purchased Energy) Kw.-Hr.	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*)	O fo (In Pu E K
(1)	(2)	(3)	(4)	(5)	(6)	
	United States					
1	Niagara Hudson Power Corporation (*C*)	(*o*) 1,155,400	(*o*) 1,019,600	7,063,367,862	(*o*) 1,098,900	6,39
2	Consolidated Gas Co. of N. Y. Elec. Cos. Affil. With The (*H*)	1,307,000	1,231,000	5,493,400,000	1,224,000	5,27
3	Pacific Gas and Electric Company	857,900	.....	4,463,309,951	827,800	4,41
4	Commonwealth Edison Company	953,000	577,000	4,191,045,000	892,000	4,04
5	American Gas and Electric Company Interconnected System*	(*o*) 733,000	(*o*) 733,000	3,819,332,352	(*o*) 628,000	3,40
6	Philadelphia Electric Company System	745,000	746,000	3,210,338,623	675,000	3,09
7	Southern California Edison Company Ltd	561,900	560,000	3,139,306,603	516,300	2,91
8	The Detroit Edison Company	557,200	554,000	2,534,561,100	481,800	2,20
9	Public Service Electric and Gas Company (N. J.)	526,600	510,000	2,269,424,555	489,700	2,13
10	New England Power Association and Sub. Cos	498,600	421,500	2,188,886,998	472,700	1,98
11	The West Penn Electric Co. & Sub. Co's	(*o*) 374,784	(*o*) 370,300	2,068,152,932	(*o*) 320,309	1,78
12	Union Electric Light & Power Co. (Mo.) and Subsidiaries*	(*m*) 389,548	.....	2,009,565,810	(*m*) 348,220	1,81
13	Alabama Power Company	(*o*) 408,120	(*o*) 406,200	1,942,585,912	(*o*) 391,340	1,71
14	Duke Power Company	(*m*) 440,000	(*m*) 354,000	1,792,111,249	(*m*) 410,000	1,64
15	Public Service Company of Northern Illinois	193,531	(*j*) 234,272	1,696,756,840	(*j*) 182,605	1,60
16	Pennsylvania Power & Light Company	(*o*) 304,800	.....	1,522,748,500	(*o*) 310,000	1,48
17	The Cleveland Electric Illuminating Company	333,782	333,782	1,457,969,255	307,828	1,34
18	Georgia Power Company	(*o*) 325,909	(*o*) 286,640	1,445,556,056	(*o*) 282,500	1,20
19	Pennsylvania Water & Power Co. and Safe Harbor W. P. Corp. (*f*)	(*o*) 328,500	(*o*) 328,500	1,429,694,400	(*o*) 293,900	1,21
20	Duquesne Light Company	(*m*) 295,000	(*m*) 295,000	1,403,252,940	(*m*) 270,000	1,33
21	Super-Power Company of Illinois	225,000	225,000	1,346,251,000	223,500	1,31
22	Montana Power Company	(*o*) 203,400	.....	1,292,318,000	(*o*) 169,500	1,01
23	Columbia Gas & Electric Corporation and Subsidiary Cos	308,530	.....	1,252,490,212	257,860	1,12
24	Consumers Power Company	(*o*) 281,878	(*o*) 257,531	1,233,811,914	(*o*) 221,330	1,06
25	The Edison Electric Illuminating Company of Boston	(*m*) 321,842	(*m*) 251,000	1,224,562,906	(*m*) 288,545	1,11
26	The Milwaukee Electric Ry. & Light Co. and Affil. Cos.*	(*m*) 262,718	.....	1,210,496,055	(*m*) 227,410	1,07
27	Chicago District Electric Generating Corporation	196,776	196,776	1,168,934,000	199,536	1,21
28	Consolidated Gas Electric Light & Power Co. of Baltimore	(*e*) 244,300	(*o*) 102,500	*g* 1,113,560,084	(*e*) 209,600	(*g*) 99
29	Northern States Power Company	(*m*) 243,534	.....	1,098,471,563	225,448	1,02
30	Carolina Power & Light Company	(*o*) 237,360	.....	1,059,547,400	(*o*) 239,720	1,10
31	Puget Sound Power & Light Company	(*m*) 205,435	(*m*) 202,635	914,812,000	(*m*) 192,568	85
32	Ohio Edison Company	(*o*) 179,600	(*o*) 174,500	876,899,592	(*o*) 163,000	79
33	Washington Water Power Company (The)	(*o*) 170,720	.....	854,380,000	(*o*) 143,420	76
34	City of Los Angeles, Bureau of Power & Light	183,200	108,300	798,261,643	171,300	74
35	Associated Gas & Elec. System (Eastern Pa. & N. J. Group)	(*o*) 170,400	(*o*) 153,200	795,377,813	(*o*) 148,400	....
36	The Tennessee Electric Power Company	(*o*) 152,900	(*o*) 85,900	782,935,160	(*o*) 130,000	72
37	Potomac Electric Power Company*	(*m*) 169,000	.....	725,463,909	(*m*) 164,000	66
38	Kansas City Power & Light Company	(*c*) 132,400	(*c*) 129,900	652,654,977	(*c*) 126,200	62
39	Public Service Company of Indiana (*L*)	131,870	108,700	642,607,543	120,900	58
40	The Connecticut Light & Power Company*	(*o*) 137,053	.....	632,021,404	(*o*) 116,716	56
41	Portland General Electric Company	(*o*) 130,000	(*o*) 128,000	583,071,000	(*o*) 118,000	54
42	Louisiana Power & Light Company	(*o*) 105,428	.....	572,219,000	(*o*) 106,377	58
43	Utah Power & Light Company	(*o*) 115,160	.....	564,307,000	(*o*) 95,510	51
44	Virginia Electric and Power Company	110,500	.....	531,014,980	102,900	52
45	Houston Lighting & Power Company	(*o*) 99,800	.....	517,942,000	(*o*) 90,000	48
46	California Oregon Power Company	98,950	98,950	515,252,331	86,940	48
47	Hetch Hetchy Water Supply, Power Division (San Francisco)	83,700	83,700	507,977,590	83,600	50
48	Oklahoma Gas & Electric Co	(*m*) 97,689	(*m*) 97,689	507,655,960	(*m*) 89,270	46
49	New York State Elec. & Gas Corp. Group (Assoc. G. & E. System)	(*o*) 88,552	(*o*) 55,957	505,251,769	(*o*) 93,488	47
50	The Toledo Edison Company	98,000	87,000	492,963,903	91,120	43
51	Northern Indiana Public Service Company	88,016	.....	463,600,194	75,160	40
52	Constituent Utility Companies of Western Mass. Cos	85,600	.....	460,014,000	78,100	43
53	Central Maine Power Company	89,640	88,061	459,905,610	91,740	44
54	The Ohio Public Service Company	104,500	86,600	453,088,903	95,000	43
55	Texas Power & Light Company	(*o*) 89,200	.....	448,880,000	(*o*) 91,000	44

Supplement to ELECTRICAL WORLD, May 9, 1936
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eak Load of Largest Generating and Di
North America, 1928—1935

ilway systems in the United States, Canada and Mexico having output in excess of 100,000,000 kw.-hr. during 1935 or earlier yea

4	1933			1932			1931			1930	
Output for Year (Including Purchased Energy) Kw.-Hr. (7)	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (8)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (9)	Output for Year (Including Purchased Energy) Kw.-Hr. (10)	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (11)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (12)	Output for Year (Including Purchased Energy) Kw.-Hr. (13)	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (14)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (15)	Output for Year (Including Purchased Energy) Kw.-Hr. (16)	System Peak Load (Over 30-Minute Period) Kw. (See Note *a*) (17)	Out for (Incl Purc Ene Kw. (1
6,393,718,637	1,046,700	(*o*) 823,300	5,968,613,505	(*o*) 923,368	(*o*) 796,400	5,378,434,187	998,876	850,218	5,911,409,390	1,091,910	6,892,
5,278,800,000	1,176,000	1,104,000	5,015,100,000	1,189,400	1,189,400	4,981,200,000	1,240,000	1,240,000	5,138,200,000	1,226,000	4,983,
4,418,302,218	754,800	.....	4,048,123,590	728,900	.....	4,004,245,763	855,500	.....	4,558,552,038	853,300	4,546,
4,041,115,000	885,000	504,750	3,801,321,000	(*b*) 855,000	537,000	3,686,443,000	(*b*) 902,500	616,550	4,226,257,000	969,800	4,582,
3,401,515,706	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3,098,745,669	.....	619,000	2,946,680,745	.....	626,000	2,860,721,532	.....	668,000	3,032,323,879	(*G*) 670,000	3,091,
2,917,592,590	508,700	506,800	2,772,640,491	516,500	514,400	2,856,602,851	558,200	554,900	3,061,836,977	(*m*) 582,900	3,168,
2,204,957,700	.....	415,200	1,908,671,712	420,300	.....	1,851,223,900	477,700	.....	2,170,254,600	526,800	2,384,
2,135,937,213	488,900	463,250	2,038,096,250	456,100	373,850	2,037,604,869	462,700	366,500	2,170,512,600	506,500	2,173,
1,987,775,852	(*o*) 451,900	.....	2,011,436,299	(*o*) 467,300	.....	2,032,576,325	(*o*) 484,000	.....	1,987,327,572	411,000	1,590,
1,781,782,229	(*o*) 306,061	(*o*) 305,501	1,657,437,659	(*o*) 260,971	.....	1,457,715,339	(*o*) 306,845	.....	1,693,855,089	345,720	1,875,
1,812,642,254	318,390	.....	1,696,604,921	329,506	.....	1,650,408,229	384,324	.....	1,868,194,882	(*m*) 370,072	1,954,
1,719,797,790	(*o*) 390,720	.....	1,601,049,505	389,120	343,400	1,406,939,956	(*o*) 402,810	.....	1,860,805,943	416,750	1,707,
1,641,748,841	403,100	300,000	1,765,737,132	405,400	334,300	1,649,582,952	412,000	322,000	1,768,184,411	421,000	1,762,
1,601,519,733	180,144	(*j*) 218,960	1,519,982,344	173,470	(*j*) 223,476	1,331,986,990	191,661	(*j*) 195,545	1,361,938,056	186,869	1,361,
1,482,348,500	(*o*) 280,100	(*o*) 198,940	1,402,223,178	(*o*) 281,600	(*o*) 229,200	1,382,587,998	(*o*) 291,600	(*o*) 231,200	1,483,177,247	298,500	1,443,
1,341,905,510	309,392	.....	1,240,542,167	283,900	.....	1,201,175,042	309,556	.....	1,316,116,027	(*m*) 323,367	1,370,
1,206,988,603	(*o*) 284,860	.....	1,252,193,279	(*o*) 275,660	(*o*) 268,170	1,163,107,611	270,000	.....	1,319,011,309	301,955	1,364,
1,216,668,900	(*o*) 256,800	(*o*) 256,800	1,314,265,000	(*o*) 222,100	(*o*) 222,100	933,430,500	(*o*) 126,500	(*o*) 126,500	506,218,600	127,900	527,
1,331,858,000	264,000	264,000	1,211,956,122	245,000	245,000	1,176,868,998	289,000	289,000	1,364,318,513	304,000	1,510,
1,311,334,520	227,400	222,000	1,246,053,446	237,600	223,000	1,232,552,866	236,700	231,800	1,253,830,208	158,400	729,
1,011,018,000	159,600	159,600	889,321,000	119,700	119,700	613,026,278	145,700	145,700	937,014,000	216,000	1,293,
1,121,784,195	261,000	.....	1,045,236,270	249,900	.....	1,072,227,180	266,540	.....	1,162,409,020	262,000	1,161,
1,067,119,750	(*o*) 210,467	.....	928,828,246	237,343	197,592	894,759,956	242,700	.....	1,016,384,395	248,000	1,072,
1,112,072,477	283,595	219,000	1,073,311,339	265,563	213,000	1,048,824,142	281,787	231,210	1,048,605,842	(*m*) 289,017	1,073,
1,070,722,170	221,693	.....	974,871,307	231,969	.....	971,760,512	261,322	.....	1,125,840,103	(*m*) 276,586	1,243,
1,217,650,000	193,128	193,128	1,042,475,756	190,848	190,848	940,504,000	191,232	191,232	1,009,506,000	198,324	1,039,
(*g*) 994,508,550	(*e*) 198,000	(*o*) 74,200	(*g*) 897,675,028	(*o*) 180,400	(*o*) 119,900	843,522,718	(*o*) 181,500	(*o*) 162,500	884,250,577	188,200	933,
1,029,299,544	.....	.....	963,928,433	204,461	.....	974,484,310	227,971	.....	1,064,002,895	210,000	1,024,
1,103,009,000	(*o*) 234,250	(*o*) 170,920	966,328,322	(*o*) 208,600	(*o*) 178,750	814,270,505	(*o*) 217,000	(*o*) 171,300	731,648,290	188,000	564,
851,144,000	179,795	170,295	788,481,852	177,255	148,763	824,481,187	185,630	.....	911,955,295	192,623	980,
799,540,789	(*o*) 145,200	.....	715,770,350	(*o*) 153,000	(*o*) 134,700	693,551,026	.....	.....	849,713,467	.....	980,
762,886,000	118,785	118,785	634,984,182	128,135	128,135	647,596,251	(*o*) 152,420	(*o*) 152,420	784,134,417	155,960	850,
744,453,705	159,600	95,500	712,102,112	167,400	94,500	722,331,128	169,000	84,700	759,028,656	170,000	759,
.....	(*o*) 147,900	(*o*) 138,300	713,137,805	(*o*) 143,860	(*o*) 125,590	664,678,386	(*o*) 151,870	(*o*) 151,870	706,351,308	158,140	725,
721,676,085	(*o*) 110,300	.....	575,047,467	145,740	106,260	536,913,727	165,000	.....	762,528,751	150,965	783,
662,832,609	148,000	.....	562,432,866	137,000	137,000	542,527,569	130,000	130,000	519,295,192	(*m*) 123,000	488,
626,908,653	.....	120,600	596,988,080	128,200	.....	615,730,828	131,000	.....	629,935,369	136,200	647,
580,038,341	118,450	100,300	530,805,379	116,980	.....	533,569,196	72,588	40,775	320,594,122	.....	.....
565,072,385	(*o*) 116,719	.....	557,824,571	(*o*) 114,425	.....	536,775,777	(*o*) 115,241	.....	552,059,756	115,629	568,
541,574,500	(*o*) 109,000	(*o*) 109,000	496,188,200	(*o*) 108,300	(*o*) 126,000	514,789,600	(*o*) 130,900	(*o*) 130,400	603,182,100	128,000	589,
583,409,000	110,188	97,000	530,645,000	112,988	103,000	551,155,000	112,091	96,151	612,119,000	108,361	596,
518,737,000	90,710	66,340	476,411,537	103,710	67,160	493,678,000	119,390	100,500	650,549,000	(*m*) 135,405	746,
520,749,516	102,400	92,000	506,712,794	104,200	97,500	507,496,464	107,600	.....	534,628,983	108,100	514,
482,255,000	83,000	80,900	442,468,000	(*o*) 82,600	(*o*) 79,500	435,971,000	(*o*) 96,210	(*o*) 93,100	524,913,000	103,900	566,
488,083,257	83,565	80,800	478,306,895	84,700	81,795	471,471,767	92,425	81,760	465,156,805	(*m*) 83,540	476,
502,306,335	84,600	84,600	469,418,170	83,600	83,600	507,323,840	83,600	83,600	309,450,010	83,600	493,
462,518,117	83,678	80,178	429,121,897	83,152	.....	430,351,857	99,494	95,530	489,174,640	114,500	643,
475,868,791	(*o*) 101,730	(*o*) 49,188	437,172,115	(*o*) 74,500	(*o*) 38,000	412,760,797	(*o*) 89,500	(*o*) 33,500	430,009,374	.....	444,
430,527,039	(*o*) 87,000	(*o*) 86,792	412 111,501	(*o*) 95,400	(*o*) 81,000	389,779,858	(*o*) 107,030	(*o*) 95,000	452,178,712	123,230	468,
409,796,055	70,450	.....	403,796,004	72,600	70,000	373,324,371	76,650	.....	423,230,408	68,740	370,
430,668,000	74,800	.....	412,011,000	76,700	.....	433,146,000	86,100	85,100	443,000,000	93,100	476,
448,791,884	90,205	85,070	405,825,340	(*o*) 85,750	.....	361,974,791	(*o*) 88,070	.....	440,667,827	69,200	295,
437,060,257	(*o*) 95,900	(*o*) 63,700	408,607,809	(*o*) 90,300	(*o*) 56,200	395,239,555	(*o*) 103,200	(*o*) 71,000	455,840,667	118,300	553,
444,191,000	(*o*) 101,630	(*o*) 82,240	482,671,000	(*o*) 102,540	(*o*) 82,630	435,440,000	(*o*) 105,225	(*o*) 89,890	445,325,000	98,405	440,

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Output and Peak Load of Largest Ge
in North America, 1928—

Public utility, lighting, power and electric railway systems in the United States, Canada and Mexico having output in exc

		1935			1934		1933			1932		
		System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (3)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (4)	Output for Year (Including Purchased Energy) Kw.-Hr. (5)	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (6)	Output for Year (Including Purchased Energy) Kw.-Hr. (7)	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (8)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (9)	Output for Year (Including Purchased Energy) Kw.-Hr. (10)	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (11)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (12)	Output for Year (Including Purchased Energy) Kw.-Hr. (13)
		(*o*) 1,155,400	(*o*) 1,019,600	7,063,367,862	(*o*) 1,098,900	6,393,718,637	1,046,700	(*o*) 823,300	5,968,613,505	(*o*) 923,368	(*o*) 796,400	5,378,434,187
		1,307,000	1,231,000	5,493,400,000	1,224,000	5,278,800,000	1,176,000	1,104,000	5,015,100,000	1,189,400	1,189,400	4,981,200,000
		857,900		4,463,309,951	827,800	4,418,302,218	754,800		4,048,123,590	728,900		4,004,245,763
		953,000	577,000	4,191,045,000	892,000	4,041,115,000	885,000	504,750	3,801,321,000	(*b*) 855,000	537,000	3,686,443,000
		(*o*) 733,000	(*o*) 733,000	3,819,332,352	(*o*) 628,000	3,401,515,706						
		745,000	746,000	3,210,338,623	675,000	3,098,745,669		619,000	2,946,680,745		626,000	2,860,721,532
		561,900	560,000	3,139,306,603	516,300	2,917,592,590	508,700	506,800	2,772,640,491	516,500	514,400	2,856,602,851
		557,200	554,000	2,534,561,100	481,800	2,204,957,700		415,200	1,908,671,712	420,300		1,851,223,900
		526,600	510,000	2,269,424,555	489,700	2,135,937,213	488,900	463,250	2,038,096,250	456,100	373,850	2,037,604,869
		498,600	421,500	2,188,886,998	472,700	1,987,775,852	(*o*) 451,900		2,011,436,299	(*o*) 467,300		2,032,576,325
		(*o*) 374,784	(*o*) 370,300	2,068,152,932	(*o*) 320,309	1,781,782,229	(*o*) 306,061	(*o*) 305,501	1,657,437,659	(*o*) 260,971		1,457,715,339
		(*m*) 389,548		2,009,565,810	(*m*) 348,220	1,812,642,254	318,390		1,696,604,921	329,506		1,650,408,229
		(*o*) 408,120	(*o*) 406,200	1,942,585,912	(*o*) 391,340	1,719,797,790	(*o*) 390,720		1,601,049,505	389,120	343,400	1,406,939,956
		(*m*) 440,000	(*m*) 354,000	1,792,111,249	(*m*) 410,000	1,641,748,841	403,100	300,000	1,765,737,132	405,400	334,300	1,649,582,952
		193,531	(*j*) 234,272	1,696,756,840	(*j*) 182,605	1,601,519,733	180,144	(*j*) 218,960	1,519,982,344	173,470	(*j*) 223,476	1,331,986,990
		(*o*) 304,800		1,522,748,500	(*o*) 310,000	1,482,348,500	(*o*) 280,100	(*o*) 198,940	1,402,223,178	(*o*) 281,600	(*o*) 229,200	1,382,587,998
		333,782	333,782	1,457,969,255	307,828	1,341,905,510	309,392		1,240,542,167	283,900		1,201,175,042
		(*o*) 325,909	(*o*) 286,640	1,445,556,056	(*o*) 282,500	1,206,988,603	(*o*) 284,860		1,252,193,279	(*o*) 275,660	(*o*) 268,170	1,163,107,611
)		(*o*) 328,500	(*o*) 328,500	1,429,694,400	(*o*) 293,900	1,216,668,900	(*o*) 256,800	(*o*) 256,800	1,314,265,000	(*o*) 222,100	(*o*) 222,100	933,430,500
		(*m*) 295,000	(*m*) 295,000	1,403,252,940	(*m*) 270,000	1,331,858,000	264,000	264,000	1,211,956,122	245,000	245,000	1,176,868,998
		225,000	225,000	1,346,251,000	223,500	1,311,334,520	227,400	222,000	1,246,053,446	237,600	223,000	1,232,552,866
		(*o*) 203,400		1,292,318,000	(*o*) 169,500	1,011,018,000	159,600	159,600	889,321,000	119,700	119,700	613,026,278
		308,530		1,252,490,212	257,860	1,121,784,195	261,000		1,045,236,270	249,900		1,072,227,180
		(*o*) 281,878	(*o*) 257,531	1,233,811,914	(*o*) 221,330	1,067,119,750	(*o*) 210,467		928,828,246	237,343	197,592	894,759,956
		(*m*) 321,842	(*m*) 251,000	1,224,562,906	(*m*) 288,545	1,112,072,477	283,595	219,000	1,073,311,339	265,563	213,000	1,048,824,142
		(*m*) 262,718		1,210,496,055	(*m*) 227,410	1,070,722,170	221,693		974,871,307	231,969		971,760,512
		196,776	196,776	1,168,934,000	199,536	1,217,650,000	193,128	193,128	1,042,475,756	190,848	190,848	940,504,000
		(*e*) 244,300	(*o*) 102,500	*g* 1,113,560,084	(*e*) 209,600	(*g*) 994,508,550	(*e*) 198,000	(*o*) 74,200	(*g*) 897,675,028	(*o*) 180,400	(*o*) 119,900	843,522,718
		(*m*) 243,534		1,098,471,563	225,448	1,029,299,544			963,928,433	204,461		974,484,310
		(*o*) 237,360		1,059,547,400	(*o*) 239,720	1,103,009,000	(*o*) 234,250	(*o*) 170,920	966,328,322	(*o*) 208,600	(*o*) 178,750	814,270,505
		(*m*) 205,435	(*m*) 202,635	914,812,000	(*m*) 192,568	851,144,000	179,795	170,295	788,481,852	177,255	148,763	824,481,187
		(*o*) 179,600	(*o*) 174,500	876,899,592	(*o*) 163,000	799,540,789	(*o*) 145,200		715,770,350	(*o*) 153,000	(*o*) 134,700	693,551,026
		(*o*) 170,720		854,380,000	(*o*) 143,420	762,886,000	118,785	118,785	634,984,182	128,135	128,135	647,596,25
		183,200	108,300	798,261,643	171,300	744,453,705	159,600	95,500	712,102,112	167,400	94,500	722,331,120
		(*o*) 170,400	(*o*) 153,200	795,377,813	(*o*) 148,400		(*o*) 147,900	(*o*) 138,300	713,137,805	(*o*) 143,860	(*o*) 125,590	664,678,386
		(*o*) 152,900	(*o*) 85,900	782,935,160	(*o*) 130,000	721,676,085	(*o*) 110,300		575,047,467	145,740	106,260	536,913,727
		(*m*) 169,000		725,463,909	(*m*) 164,000	662,832,609	148,000		562,432,866	137,000	137,000	542,527,569
		(*c*) 132,400	(*c*) 129,900	652,654,977	(*c*) 126,200	626,908,653		120,600	596,988,080	128,200		615,730,828
		131,870	108,700	642,607,543	120,900	580,038,341	118,450	100,300	530,805,379	116,980		533,569,196
		(*o*) 137,053		632,021,404	(*o*) 116,716	565,072,385	(*o*) 116,719		557,824,571	(*o*) 114,425		536,775,777
		(*o*) 130,000	(*o*) 128,000	583,071,000	(*o*) 118,000	541,574,500	(*o*) 109,000	(*o*) 109,000	496,188,200	(*o*) 108,300	(*o*) 126,000	514,789,600
		(*o*) 105,428		572,219,000	(*o*) 106,377	583,409,000	110,188	97,000	530,645,000	112,988	103,000	551,155,000
		(*o*) 115,160		564,307,000	(*o*) 95,510	518,737,000	90,710	66,340	476,411,537	103,710	67,160	493,678,000
		110,500		531,014,980	102,900	520,749,516	102,400	92,000	506,712,794	104,200	97,500	507,496,464
		(*o*) 99,800		517,942,000	(*o*) 90,000	482,255,000	83,000	80,900	442,468,000	(*o*) 82,600	(*o*) 79,500	435,971,000
		98,950	98,950	515,252,331	86,940	488,083,257	83,565	80,800	478,306,895	84,700	81,795	471,471,767
		83,700	83,700	507,977,590	83,600	502,306,335	84,600	84,600	469,418,170	83,600	83,600	507,323,840
		(*m*) 97,689	(*m*) 97,689	507,655,960	(*m*) 89,270	462,518,117	83,678	80,178	429,121,897	83,152		430,351,853
		(*o*) 88,552	(*o*) 55,957	505,251,769	(*o*) 93,488	475,868,791	(*o*) 101,730	(*o*) 49,188	437,172,115	(*o*) 74,500	(*o*) 38,000	412,760,793
		98,000	87,000	492,963,903	91,120	430,527,039	(*o*) 87,000	(*o*) 86,792	412 111,501	(*o*) 95,400	(*o*) 81,000	389,779,858
		88,016		463,600,194	75,160	409,796,055	70,450		403,796,004	72,600	70,000	373,324,37
		85,600		460,014,000	78,100	430,668,000	74,800		412,011,000	76,700		433,146,000
		89,640	88,061	459,905,610	91,740	448,791,884	90,205	85,070	405,825,340	(*o*) 85,750		361,974,79
		104,500	86,600	453,088,903	95,000	437,060,257	(*o*) 95,900	(*o*) 63,700	408,607,809	(*o*) 90,300	(*o*) 56,200	395,239,55
		(*o*) 89,200		448,880,000	(*o*) 91,000	444,191,000	(*o*) 101,630	(*o*) 82,240	482,671,000	(*o*) 102,540	(*o*) 82,630	435,440,000
	44	Virginia Electric and Power Company					110,500		531,014,980		102,900	
	45	Houston Lighting & Power Company					(*o*) 99,800		517,942,000	(*o*) 90,000		
	54	The Ohio Public Service Company					104,500	86,600	453,088,903	95,000		
	55	Texas Power & Light Company					(*o*) 89,200		448,880,000	(*o*) 91,000		

enerating and Distributing Systems
–1935

excess of 100,000,000 kw.-hr. during 1935 or earlier year

	1931			1930		1929		1928		
	System Peak Load (30-Minute) Incl. Purchased Energy Kw. (See Note *a*) (14)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*) (15)	Output for Year (Including Purchased Energy) Kw.-Hr. (16)	System Peak Load (Over 30-Minute Period) Kw. (See Note *a*) (17)	Output for Year (Including Purchased Energy) Kw.-Hr. (18)	System Peak Load (Over 30-Minute Period) Kw. (See Note *a*) (19)	Output for Year (Including Purchased Energy) Kw.-Hr. (20)	System Peak Load (Over 30-Minute Period) Kw. (See Note *a*) (21)	Output for Year (Including Purchased Energy) Kw.-Hr. (22)	Line No. (23)
4,187	998,876	850,218	5,911,409,390	1,091,910	6,892,316,698	(*m*) 1,148,600	7,212,743,072			1
0,000	1,240,000	1,240,000	5,138,200,000	1,226,000	4,983,500,000	1,209,000	4,678,700,000	1,125,000	4,210,700,000	2
5,763	855,500		4,558,552,038	853,300	4,546,499,302	(*m*) 513,800	2,717,874,472	(*m*) 484,600	2,545,713,564	3
3,000	(*b*) 902,500	616,550	4,226,257,000	969,800	4,582,510,000	1,000,200	4,636,434,000	1,016,000	4,174,661,000	4
										5
1,532		668,000	3,032,323,879	(*G*) 670,000	3,091,233,131	(*G*) 713,000	3,029,885,631	561,400	2,266,856,345	6
2,851	558,200	554,900	3,061,836,977	(*m*) 582,900	3,168,973,397	(*m*) 571,000	3,162,988,030	(*m*) 516,100	2,762,459,843	7
3,900	477,700		2,170,254,600	526,800	2,384,528,500	547,600	2,654,901,300	507,700	2,438,304,900	8
4,869	462,700	366,500	2,170,512,600	506,500	2,173,944,354	517,225	2,134,581,298	471,000	1,879,024,063	9
6,325	(*o*) 484,000		1,987,327,572	411,000	1,590,215,715	395,000	1,703,536,819	315,000	1,384,834,239	10
5,339	(*o*) 306,845		1,693,855,089	345,720	1,875,470,490	362,787	1,938,955,818	319,325	1,764,742,160	11
8,229	384,324		1,868,194,882	(*m*) 370,072	1,954,460,032	(*m*) 350,000	1,871,797,392	(*m*) 355,611	1,719,825,708	12
9,956	(*o*) 402,810		1,860,805,943	416,750	1,707,945,749	376,400	1,715,250,122	338,600	1,586,177,553	13
2,952	412,000	322,000	1,768,184,411	421,000	1,762,798,306	432,000	1,981,239,709	422,600	1,847,072,621	14
6,990	191,661	(*j*) 195,545	1,361,938,056	186,869	1,361,763,671	190,123	1,246,330,283	178,016	1,047,466,830	15
7,998	(*o*) 291,600	(*o*) 231,200	1,483,177,247	298,500	1,443,264,200	285,800	1,251,104,868	(*m*) 253,000	1,176,653,000	16
5,042	309,556		1,316,116,027	(*m*) 323,367	1,370,467,732	(*m*) 315,870	1,447,193,594	(*m*) 331,768	1,282,476,855	17
7,611	270,000		1,319,011,309	301,955	1,364,739,226	257,125	1,146,516,743	223,700	909,962,847	18
0,500	(*o*) 126,500	(*o*) 126,500	506,218,600	127,900	527,694,000	129,600	610,962,200	124,500	655,035,700	19
8,998	289,000	289,000	1,364,318,513	304,000	1,510,950,299		1,573,445,327	(*m*) 295,300	1,434,185,024	20
2,866	236,700	231,800	1,253,830,208	158,400	729,805,500					21
6,278	145,700	145,700	937,014,000	216,000	1,293,449,000	229,800	1,611,521,000		1,583,985,000	22
7,180	266,540		1,162,409,020	262,000	1,161,459,375	261,000	1,203,652,405	249,000	1,052,549,327	23
9,956	242,700		1,016,384,395	248,000	1,072,090,387	270,772	1,198,947,711	230,000	1,102,278,322	24
4,142	281,787	231,210	1,048,605,842	(*m*) 289,017	1,073,796,288	(*m*) 275,501	1,041,388,668	(*m*) 252,777	857,209,496	25
0,512	261,322		1,125,840,103	(*m*) 276,586	1,243,228,676	(*m*) 284,359	1,311,738,004	(*m*) 262,860	1,148,886,380	26
4,000	191,232	191,232	1,009,506,000	198,324	1,039,422,000	163,900	430,779,000			27
2,718	(*o*) 181,500	(*o*) 162,500	884,250,577	188,200	933,093,920	186,000	910,934,486	167,900	825,430,643	28
4,310	227,971		1,064,002,895	210,000	1,024,205,047		969,071,015		908,760,906	29
0,505	(*o*) 217,000	(*o*) 171,300	731,648,290	188,000	564,056,174	108,000	476,878,300	(*m*) 107,000	430,427,600	30
1,187	185,630		911,955,295	192,623	980,325,415	(*m*) 193,392	941,992,205	(*m*) 169,219	877,953,546	31
1,026			849,713,467		980,578,309					32
6,251	(*o*) 152,420	(*o*) 152,420	784,134,417	155,960	850,025,000	172,735	858,353,000		746,709,000	33
1,128	169,000	84,700	759,028,656	170,000	759,852,996	161,000	722,998,796	152,000	639,415,709	34
8,386	(*o*) 151,870	(*o*) 151,870	706,351,308	158,140	725,194,632	158,320	735,612,022	143,500	645,621,149	35
3,727	165,000		762,528,751	150,965	783,433,211	157,600	819,723,857	145,300	730,061,103	36
7,569	130,000	130,000	519,295,192	(*m*) 123,000	488,533,981	118,000	449,794,685	108,000	413,992,663	37
0,828	131,000		629,935,369	136,200	647,940,872	132,400	645,165,032	120,300	584,714,544	38
9,196	72,588	40,775	320,594,122							39
5,777	(*o*) 115,241		552,059,756	115,629	568,625,609	123,915	580,426,439		445,804,848	40
9,600	(*o*) 130,900	(*o*) 130,400	603,182,100	128,000	589,240,400	123,600	603,423,300	128,500	549,922,100	41
5,000	112,091	96,151	612,119,000	108,361	596,413,000	110,464	511,225,000		390,533,000	42
8,000	119,390	100,500	650,549,000	(*m*) 135,405	746,475,000	142,505	882,360,000	(*m*) 132,390	830,862,000	43
6,464	107,600		534,628,983	108,100	514,453,563	101,800	480,970,175	95,100	440,886,606	44
1,000	(*o*) 96,210	(*o*) 93,100	524,913,000	103,900	566,409,000	96,205	510,247,000	(*m*) 82,600	436,633,000	45
1,767	92,425	81,760	465,156,805	(*m*) 83,540	476,173,234	(*m*) 94,575	410,083,711		441,845,615	46
3,840	83,600	83,600	309,450,010	83,600	493,888,420	83,400	464,339,110	82,400	528,895,495	47
1,857	99,494	95,530	489,174,640	114,500	643,486,718		692,070,936		567,869,411	48
0,797	(*o*) 89,500	(*o*) 33,500	430,009,374		444,904,828		377,746,958			49
9,858	(*o*) 107,030	(*o*) 95,000	452,178,712	123,230	468,679,050	123,700	514,989,108	100,020	458,973,651	50
4,371	76,650		423,230,408	68,740	370,866,979	66,928	334,913,629	52,094	302,031,809	51
6,000	86,100	85,100	443,000,000	93,100	476,000,000	105,100	494,805,982			52
4,791	(*o*) 88,070		440,667,827	69,200	295,981,170	53,045	270,606,693	53,200	240,169,182	53
9,555	(*o*) 103,200	(*o*) 71,000	455,840,667	118,300	553,277,582	114,900	611,482,217	111,800	559,090,541	54
0,000	(*o*) 105,225	(*o*) 89,890	445,325,000	98,405	440,721,000	102,780	442,818,000		374,563,000	55
20,749,516	102,400	92,000	506,712,794	104,200	97,500	507,496,464	107,600		534,628,983	108,100	514,
482,255,000	83,000	80,900	442,468,000	(*o*) 82,600	(*o*) 79,500	435,971,000	(*o*) 96,210	(*o*) 93,100	524,913,000	103,900	566,

		85,600		460,014,000		78,100	430,668,000		74,800			412,011,000		76,700			433,146,000	
		89,640	88,061	459,905,610		91,740	448,791,884		90,205		85,070	405,825,340	(o)	85,750			361,974,79	
		104,500	86,600	453,088,903		95,000	437,060,257	(o)	95,900	(o)	63,700	408,607,809	(o)	90,300	(o)	56,200	395,239,55	
	(o)	89,200		448,880,000	(o)	91,000	444,191,000	(o)	101,630	(o)	82,240	482,671,000	(o)	102,540	(o)	82,630	435,440,00	
44				Virginia Electric and Power Company			110,500					531,014,980				102,900		62
45				Houston Lighting & Power Company	(o)	99,800						517,942,000	(o)	90,000				48
46				California Oregon Power Company			98,950		98,950			515,252,331				86,940		48
47				Hetch Hetchy Water Supply, Power Division (San Francisco)			83,700		83,700			507,977,590				83,600		50
48				Oklahoma Gas & Electric Co	(m)	97,689		(m)	97,689			507,655,960	(m)	89,270				46
49				New York State Elec. & Gas Corp. Group (Assoc. G. & E. System)	(o)	88,552		(o)	55,957			505,251,769	(o)	93,488				47
50				The Toledo Edison Company			98,000		87,000			492,963,903				91,120		43
51				Northern Indiana Public Service Company			88,016					463,600,194				75,160		40
52				Constituent Utility Companies of Western Mass. Cos			85,600					460,014,000				78,100		43
53				Central Maine Power Company			89,640		88,061			459,905,610				91,740		44
54				The Ohio Public Service Company			104,500		86,600			453,088,903				95,000		43
55				Texas Power & Light Company	(o)	89,200						448,880,000	(o)	91,000				44
56				Los Angeles Gas & Electric Corporation			102,700		117,500			437,156,341				93,800		50
57				Idaho Power Company	(o)	69,680						434,959,000	(o)	66,756				42
58				Montaup Electric Company			98,700		75,850			423,657,024				94,400		38
59				Louisville Gas & Electric Company	(m)	81,448		(m)	80,540			423,211,350	(m)	77,530				42
60				Assoc. Gas & Elec. System (So. Carolina Group)			127,700		127,700			419,331,583	(o)	130,300				38
61				Minnesota Power & Light Company	(o)	90,225						407,968,000	(o)	72,669				32
62				Assoc. Gas & Elec. System (West. Penna. Group)	(o)	83,472		(o)	83,370			400,303,230	(o)	79,560				38
63				Tennessee Valley Authority			180,000		180,000			386,600,000				133,000		20
64				Rochester Gas & Electric Corp. (Assoc. Gas & Elec. System)	(o)	80,147		(o)	54,500			384,512,454	(o)	75,729				36
65				Central Illinois Public Service Company			87,200		52,300			368,717,938				83,200		31
66				Chelan Electric Company	(o)	55,770						365,072,000	(o)	40,780				27
67				Texas Electric Service Company	(o)	75,383						357,959,000	(o)	77,957				34
68				Nevada-California Electric Corporation System (*B*)			65,700		58,500			355,878,311				61,300		34
69				Nebraska Power Company	(o)	74,280						354,800,000	(o)	68,950				34
70				Public Service Company of Colorado	(o)	79,320		(o)	78,260			354,295,874	(o)	71,950				32
71				Northwestern Electric Company	(o)	80,227						351,536,000	(o)	68,529				32
72				City of Seattle—Dept. of Lighting			88,000		80,000			349,967,300				85,000		34
73				Arkansas Power & Light Company	(o)	55,300						346,829,000	(o)	55,200				31
74				Hartford Electric Light Company			88,900		86,000			341,336,209				78,700		30
75				New Orleans Public Service Inc	(o)	79,000						339,545,000	(o)	69,500				30
76				Kentucky Utilities Company			61,800		54,800			323,462,105				62,800		28
77				The Columbus Railway, Power and Light Co	(o)	70,000		(o)	70,000			316,027,352	(o)	63,100				29
78				The United Illuminating Company				(o, h)	78,700			308,338,000	(o,h)	70,000				27
79				Central Illinois Light Company	(m)	62,667		(m)	59,700			291,344,894	(m)	52,443				26
80				Wisconsin Power and Light Company			64,100		60,165			287,192,562				65,048		27
81				Long Island Lighting Co. System			83,500		83,500			283,939,361				82,000		27
82				The Scranton Electric Company	(o)	59,600		(o)	59,600			276,436,132	(o)	56,200				25
83				City of Tacoma, Dept. of Public Utilities	(o)	55,000		(o)	67,000			276,098,322	(o)	54,000				24
84				Kansas Gas and Electric Company	(o)	51,900						265,793,700	(o)	48,400				24
85				Salt River Valley Water Users' Association			62,000		62,000			260,516,149				49,070		21
86				Gulf States Utilities Company	(o)	49,285		(o)	42,770			258,441,774	(o)	49,215				24
87				Wisconsin Public Service Corporation			51,650					258,398,400				62,200		25
88				Penn Central Light and Power Co. (Assoc. Gas & Elec. System)	(o)	54,966		(o)	54,834			253,756,501	(o)	51,095				23
89				Florida Power & Light Company	(o)	73,874						249,184,000	(o)	63,046				21
90				Virginia Public Service Co. (Assoc. Gas & Elec. System)			56,200		55,000			246,838,308				50,900		22
91				Pacific Power & Light Company	(o)	60,290						243,266,000	(o)	59,415				24
92				Jersey Central Power and Light Company	(m)	58,700		(m)	67,600			242,095,275	(m)	56,100				21
93				Dallas Power & Light Company	(o)	54,300						240,614,000	(o)	50,600				22
94				The Empire District Electric Company				(m)	50,000			240,380,110	(m)(n)	44,100				20
95				Louisiana Steam Generating Corporation				(m)	36,000			234,397,900	(m)	29,000				17
96				Birmingham Electric Company	(o)	45,712						230,824,000	(o)	42,310				21
97				West Texas Utilities Company			49,150					229,654,309				39,350		21
98				Atlantic City Electric Company	(o)	49,700		(o)	49,700			223,614,768	(o)	47,700				20
99				Southwestern Gas and Electric Company	(o)	41,680		(o)	32,940			220,277,035	(o)	39,120				21
100				Public Service Company of New Hampshire	(o)	52,730		(o)	45,130			219,205,635	(o)	49,565				20
101				Public Service Company of Oklahoma			45,000		39,500			218,847,118				40,600		20
102				Central Hudson Gas & Electric Corporation	(o)	45,500		(o)	41,100			216,374,355	(o)	45,200				20
103				Blackstone Valley Gas & Electric Company			54,082					213,154,659				49,948		17
104				Central Power and Light Company			39,540		28,280			209,740,473						20
105				San Diego Consolidated Gas & Electric Company			53,200		53,200			205,337,598				46,000		18
106				City of Detroit, Public Lighting Commission			55,300		49,000			203,623,520				51,600		20
107				Memphis Power & Light Company	(o)	46,500						197,482,000	(o)	45,100				18
108				New Bedford Gas & Edison Light Co. (Assoc. Gas & Elec. System)	(o)	48,400		(o)	48,400			196,171,710	(o)	48,000				18
109				Inland Power & Light Company	(o)	50,655						191,918,000	(o)	50,635				18
110				Iowa Public Service Co.-Sioux City Gas & Electric Co	(o)	43,779		(o)	41,355			179,573,314	(o)	41,893				16
111				San Antonio Public Service Company	(o)	38,262		(o)	28,762			178,991,700	(o)	42,167				17
112				Pennsylvania Power Company	(o)	40,000						177,678,245	(o)	34,200				15
113				Northern Indiana Power Company			41,150		12,200			177,112,090				36,100		16
114				Cumberland County Power and Light Company	(o)	52,640		(o)	38,640			169,874,630	(o)	54,860				15
115				City of Cleveland, Department of Public Utilities					39,350			168,594,800				38,100		16
116				Mississippi Power & Light Company	(o)	37,618						164,465,000	(o)	35,030				14
117				Tampa Electric Company			36,600		36,600			154,575,830				34,800		15
118				Turlock-Modesto Irrigation Districts			38,650		38,650			153,917,750				34,400		17
119				The Connecticut Power Company			38,500		11,000			147,737,000				40,200		15
120				Indiana Service Corporation			38,200		20,000			147,493,112				32,400		14
121				Interstate Power Company (Delaware) & Subsidiaries			42,120		30,515			146,820,606				39,115		14
122				Iowa Electric Light and Power Company			32,505		32,505			144,433,133				30,065		13
123				Delaware Power & Light Company			29,265					142,732,398				25,989		12
124				Luzerne County Gas and Electric Corporation	(o)	24,660		(o)	42,800			131,135,733	(o)	25,120				13
125				South Carolina Power Company	(o)	28,100		(o)	28,100			128,469,723	(o)	27,500				12
126				Iowa-Nebraska Light & Power Company and Maryville E. L. & P. Co.			29,720		20,620			125,266,928				28,200		11
127				Kansas City, Kan., Board of Public Utilities			25,500		25,500			123,564,750				26,200		12
128				Florida Power Corporation (Assoc. Gas & Elec. System)			29,000					122,754,775				25,500		10
129				Bangor Hydro-Electric Company			25,510		25,510			120,090,871				25,350		9
130				Mississippi Power Company	(o)	26,373		(o)	5,009			118,302,350	(o)	23,010				10
131				Staten Island Edison Corporation (Assoc. Gas & Elec. Sys.)	(o)	30,000			29,600			115,642,930				28,400		11
132				Western United Gas and Electric Company			24,600		28,800			114,213,818				23,270		10
133				Tennessee Public Service Company	(o)	24,256						113,953,970	(o)	20,899				9
134				City of Lansing, Board of Water & Elec. Lt. Comm'rs			30,050		30,050			107,685,118				22,345		8
135				Southern Indiana Gas and Electric Company	(m)	28,000		(m)	28,000			105,157,090	(m)	23,000				9
	(o)	99,800		517,942,000	(o)	90,000	482,255,000		83,000		80,900	442,468,000	(o)	82,600	(o)	79,500	435,971,00	

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98,138,150		18,681		100	90,238,272		20,030		101	93,796,831		22,387		77	112,918,808		23,1 4		114,
87,996,680																			
91,209,467																			
971,000	(o)	96,210	(o)	93,100	524,913,000		103,900	566,409,000		96,205	510,247,000	(m)	82,600	436,633,000	45				
471,767		92,425		81,760	465,156,805	(m)	83,540	476,173,234	(m)	94,575	410,083,711			441,845,615	46				
323,840		83,600		83,600	309,450,010		83,600	493,888,420		83,400	464,339,110		82,400	528,895,495	47				
351,857		99,494		95,530	489,174,640		114,500	643,486,718			692,070,936			567,869,411	48				
760,797	(o)	89,500	(o)	33,500	430,009,374			444,904,828			377,746,958				49				
779,858	(o)	107,030	(o)	95,000	452,178,712		123,230	468,679,050		123,700	514,989,108		100,020	458,973,651	50				
324,371		76,650			423,230,408		68,740	370,866,979		66,928	334,913,629		52,094	302,031,809	51				
146,000		86,100		85,100	443,000,000		93,100	476,000,000		105,100	494,805,982				52				
974,791	(o)	88,070			440,667,827		69,200	295,981,170		53,045	270,606,693		53,200	240,169,182	53				
239,555	(o)	103,200	(o)	71,000	455,840,667		118,300	553,277,582		114,900	611,482,217		111,800	559,090,541	54				
440,000	(o)	105,225	(o)	89,890	445,325,000		98,405	440,721,000		102,780	442,818,000			374,563,000	55				
886,410		115,900		115,900	429,006,384		115,000	388,312,942		90,000	304,100,629		81,500	269,681,600	56				
999,391	(o)	68,857	(o)	66,440	450,864,575		70,130	482,065,456		71,114	471,732,000	(m)	72,080	506,009,000	57				
403,000		89,800		77,940	435,364,000		90,200	374,034,000		101,000	338,215,600				58				
323,910					450,407,520	(m)	91,235	348,598,452			328,598,520			285,767,900	59				
764,719	(o)	123,900	(o)	123,900	425,907,556		65,100	178,976,937		53,200	162,129,679		54,800	148,932,217	60				
451,669	(o)	86,870	(o)	86,870	391,586,638		95,823	456,913,135		87,736	427,848,189	(m)	80,696	416,134,000	61				
582,826	(o)	84,300	(o)	84,000	411,565,334										62				
638,000		161,634		162,034	345,603,400		145,092	306,119,200		112,500	171,681,600		120,600	222,096,800	63				
846,546	(o)	72,727	(o)	71,227	366,281,440		78,008	387,454,655		83,023	393,506,327		75,290	376,764,523	64				
293,529		83,000			342,162,436		87,500	366,474,373		86,300	367,912,947		66,300	339,189,800	65				
															66				
534,000	(o)	86,190	(o)	82,720	521,669,355		71,780	568,018,000			665,625,000	(m)	67,494	381,404,000	67				
604,426		48,900		41,800	275,500,157		51,400	292,135,954		55,800	300,320,585		51,900	294,781,380	68				
610,700	(o)	70,600	(o)	70,600	345,568,500		65,000	320,411,600		55,000	265,901,500	(m)	47,000	219,813,000	69				
178,934	(o)	71,783	(o)	71,783	318,427,572		73,682	331,467,254		72,453	319,607,394	(m)	67,797	298,387,145	70				
388,516	(o)	54,440	(o)	50,400	287,290,707		54,160	278,947,541		56,000	286,529,056	(m)	53,100	286,820,000	71				
605,000		90,000		90,000	353,764,500		89,000	384,812,680		80,000	364,959,930		75,000	307,909,700	72				
055,000		62,500		28,300	304,690,000		66,100	331,538,000			310,955,000			259,164,000	73				
846,464	(o)	80,000	(o)	83,000	368,970,842		59,800	396,238,000		55,900	362,855,320		52,500	242,563,000	74				
521,000		74,000		74,000	341,034,400		70,100	350,484,000		68,000	345,847,000	(m)	68,000	338,629,000	75				
322,584		56,000		50,500	249,540,548		68,570	252,292,869	(m)	60,000	240,724,354		39,910	194,822,819	76				
830,100	(o)	61,000	(o)	61,000	270,864,584		71,000	294,445,800		70,000	315,558,310		60,000	283,654,155	77				
832,000					278,062,000			283,365,700			288,417,200			275,965,650	78				
320,248		35,000		0	151,421,136		37,500	171,834,023		39,400	177,338,443			156,467,174	79				
008,229		66,380		61,480	284,597,748		67,600	292,252,317		60,784	296,527,833			283,520,629	80				
926,233		70,500		70,500	244,156,063		64,900	222,301,296		48,000	197,097,106		50,000	172,923,000	81				
866,592		51,400		51,400	263,811,192	(m)	55,500	279,155,000	(m)	58,200	240,508,000	(m)	52,400	245,526,000	82				
414,450		55,000		66,000	253,913,000		53,000	254,074,415		54,300	255,771,531		49,000	208,399,465	83				
850,500		50,600		50,600	251,304,100		52,500	271,396,600		62,400	284,354,000	(m)	49,900	249,717,000	84				
951,640				63,160	292,324,270	(m)	53,370	276,816,917	(m)	46,315	188,665,617	(m)	55,200	275,550,594	85				
004,239		47,810		36,000	266,182,789		52,000	293,365,397		47,000	273,182,834		35,204	191,081,273	86				
601,100	(o)	44,600			185,877,236		48,300	205,587,325	(m)	50,400	176,194,115			149,811,913	87				
223,069				47,500	234,162,059		50,100	243,323,574		50,300	237,817,248		45,800	213,808,418	88				
622,270		65,260		64,880	208,124,600		67,940	207,310,965		59,208	202,110,030	(m)	60,708	199,322,000	89				
240,422		53,115		55,680	220,893,275		44,400	193,392,263							90				
201,401		41,250		18,325	230,487,553		42,775	220,440,374			251,759,000			232,877,000	91				
850,022		58,000		54,000	192,586,692		40,000	144,902,031							92				
154,642	(o)	52,300	(o)	52,000	220,291,750		53,000	215,889,590		55,400	199,099,200	(m)	46,400	179,165,000	93				
431,973	(o)	37,100	(o)	37,100	178,540,162		49,600	224,158,905		60,600	258,682,003	(m)	55,500	226,034,240	94				
															95				
282,094		48,363		0	252,222,842		52,464	277,437,821		54,820	292,759,162	(m)	53,720	298,379,513	96				
102,888		42,915			203,968,162		41,140	231,817,948		39,000	246,515,315		44,220	147,963,154	97				
354,557		52,900		52,900	213,819,894	(m)	50,000	201,758,000	(m)	48,000	184,172,000	(m)	41,500	148,331,000	98				
055,928				30,300	196,644,219			163,474,091			149,696,794		31,790	119,647,273	99				
063,033	(o)	43,700	(o)	42,675	181,949,548		39,700	157,222,444							100				
934,051		42,500		37,000	200,698,570		52,800	268,724,289	(m)	47,000	255,220,126		46,000	224,426,315	101				
958,106		53,500			221,840,852		50,000	195,689,541		55,400	200,566,867		53,000	213,612,676	102				
572,365	(o)	46,187	(o)	6,000	192,089,421		49,815	183,442,323		55,515	207,701,144		54,970	182,918,142	103				
637,696		48,025		43,125	249,425,222		55,270	276,668,160	(m)	42,800	239,756,655		34,845	146,744,975	104				
035,810		48,300		48,300	198,800,090		47,000	179,709,699	(m)	45,300	185,639,011			153,825,600	105				
060,990				45,000	217,010,380		44,700	206,514,320		44,000	190,900,800				106				
532,740	(o)	44,700	(o)	44,700	189,341,440		48,000	195,429,828		45,000	182,112,000	(m)	41,261	172,781,000	107				
982,440	(o)	51,200	(o)	51,200	190,585,830		53,000	195,293,900		58,000	219,020,744		56,000	167,613,529	108				
															109				
647,061		39,311			171,071,489		42,500	175,304,555		40,500	162,477,080				110				
707,153		41,700		36,500	199,783,901	(m)	54,500	238,979,012		51,600	238,200,935				111				
689,604		39,000		0	178,076,358		45,000	232,425,592							112				
816,594		80,750		68,100	448,574,681		99,070	441,309,468		93,170	424,300,963		84,205	383,337,429	113				
240,346		39,815		18,815	149,093,897		43,220	143,380,401		41,940	144,364,260		30,200	114,835,060	114				
															115				
226,989		32,074			146,433,090		31,000	138,781,877		25,508	103,748,759				116				
731,492		27,840		24,600	143,522,953	(m)	35,630	178,992,370		33,000	170,887,397	(m)	31,720	152,885,453	117				
															118				
285,039		43,452		11,140	132,960,016		24,755	139,618,715							119				
841,303		29,640		2,840	147,896,790	(m)	31,390	146,368,000	(m)	23,620	145,405,000	(m)	26,480	122,579,000	120				
742,749		40,403		33,480	141,315,424			142,532,297							121				
997,054		32,000		32,000	134,821,422										122				
849,982		28,119		0	136,633,985		27,880	137,457,239		29,700	134,571,700		23,500	122,337,055	123				
824,746	(o)	25,130	(o)	41,750	123,216,441		40,000	129,087,117		26,810	115,530,335				124				
262,093		31,200			130,897,921		26,900	121,419,692		29,440	136,213,088				125				
															126				
															127				
446,191		25,800		25,800	109,489,363	(m)	25,300	103,891,909							128				
388,626	(o)	23,830	(o)	23,830	106,550,576										129				
725,735		26,783			118,526,461		27,912	115,634,958		30,300	116,745,731		23,400	93,469,303	130				
497,340	(o)	31,700	(o)	31,700	128,454,330		31,500	142,486,580		31,800	128,665,860		28,100	117,999,180	131				
															132				
796,831		22,387		77	112,918,808		23,1 4	114,480,898		23,065	111,870,280				133				
															134				
															135				
183,657,590	(o)	48,300	(o)	48,300	179,947,100	(o)	44,200	(o)	44,200	153,982,440	(o)	51,200	(o)	51,200	190,585,830		53,000		195,
180,575,000																			

	(o)	24,256			113,953,970	(o)	20,899	98,138,150	18,681	100	90,238,272	20,030	101	93,796
		30,050		30,050	107,685,118		22,345	87,996,680						
	(m)	28,000	(m)	28,000	105,157,090	(m)	23,000	91,209,467						
108	New Bedford Gas & Edison Light Co. (Assoc. Gas & Elec. System)					(o)	48,400	(o)	48,400	196,171,710	(o)	48,000		
109	Inland Power & Light Company					(o)	50,655			191,918,000	(o)	50,635		
110	Iowa Public Service Co.-Sioux City Gas & Electric Co					(o)	43,779	(o)	41,355	179,573,314	(o)	41,893		
111	San Antonio Public Service Company					(o)	38,262	(o)	28,762	178,991,700	(o)	42,167		
112	Pennsylvania Power Company					(o)	40,000			177,678,245	(o)	34,200		
113	Northern Indiana Power Company						41,150		12,200	177,112,090		36,100		
114	Cumberland County Power and Light Company					(o)	52,640	(o)	38,640	169,874,630	(o)	54,860		
115	City of Cleveland, Department of Public Utilities								39,350	168,594,800		38,100		
116	Mississippi Power & Light Company					(o)	37,618			164,465,000	(o)	35,030		
117	Tampa Electric Company						36,600		36,600	154,575,830		34,800		
118	Turlock-Modesto Irrigation Districts						38,650		38,650	153,917,750		34,400		
119	The Connecticut Power Company						38,500		11,000	147,737,000		40,200		
120	Indiana Service Corporation						38,200		20,000	147,493,112		32,400		
121	Interstate Power Company (Delaware) & Subsidiaries						42,120		30,515	146,820,606		39,115		
122	Iowa Electric Light and Power Company						32,505		32,505	144,433,133		30,065		
123	Delaware Power & Light Company						29,265			142,732,398		25,989		
124	Luzerne County Gas and Electric Corporation					(o)	24,660	(o)	42,800	131,135,733	(o)	25,120		
125	South Carolina Power Company					(o)	28,100	(o)	28,100	128,469,723	(o)	27,500		
126	Iowa-Nebraska Light & Power Company and Maryville E. L. & P. Co.						29,720		20,620	125,266,928		28,200		
127	Kansas City, Kan., Board of Public Utilities						25,500		25,500	123,564,750		26,200		
128	Florida Power Corporation (Assoc. Gas & Elec. System)						29,000			122,754,775		25,500		
129	Bangor Hydro-Electric Company						25,510		25,510	120,090,871		25,350		
130	Mississippi Power Company					(o)	26,373	(o)	5,009	118,302,350	(o)	23,010		
131	Staten Island Edison Corporation (Assoc. Gas & Elec. Sys.)					(o)	30,000		29,600	115,642,930		28,400		
132	Western United Gas and Electric Company						24,600		28,800	114,213,818		23,270		
133	Tennessee Public Service Company					(o)	24,256			113,953,970	(o)	20,899		
134	City of Lansing, Board of Water & Elec. Lt. Comm'rs						30,050		30,050	107,685,118		22,345		
135	Southern Indiana Gas and Electric Company					(m)	28,000	(m)	28,000	105,157,090	(m)	23,000		
136	El Paso Electric Company					(m)	23,500	(m)	23,500	103,776,867	(m)	22,000		
137	City of Jacksonville Municipal Elec. Lt. Plant					(m)	25,500	(m)	25,500	103,750,200	(m)	24,800		
138	Central Illinois Electric and Gas Company						24,000			103,563,210				
139	Des Moines Electric Light Company (*E*)								45,000	206,358,724		44,000		
139a	Indianapolis Power & Light Company (*E*)						82,150		81,450	360,488,633		72,100		
	Total for United States (*C*)									102,894,925,190				98,3
	Canada													
140	Hydro-Electric Power Commission of Ontario						1,319,000		872,000	6,954,453,468		1,215,000		6,4
141	Shawinigan Water & Power Co. (*A*)						829,100		590,900	4,777,711,082		788,400		4,5
142	Canadian Hydro-Electric Corporation, Ltd.						484,534		483,684	2,843,388,706		493,561		2,7
143	Saguenay Power Company, Ltd							(o)	363,000	2,220,640,856				1,9
144	Montreal Light, Heat & Power Consolidated						426,700		156,000	2,071,625,524		362,250		1,8
145	West Kootenay Power and Light Co., Ltd								121,400	916,891,229		115,000		
146	Alcoa Power Company, Ltd						160,000		160,000	832,239,594		160,000		
147	Beauharnois Light, Heat & Power Co						222,200		222,200	825,901,000		172,200		
148	Winnipeg Electric Company (*J*)						145,300			657,958,100		110,900		
149	Canada Northern Power Corporation, Ltd						79,200		64,800	577,265,540		72,700		
150	City of Winnipeg Hydro-Electric System						95,500		90,883	552,752,450		96,200		
151	Canadian Niagara Power Company, Ltd								74,600	525,570,000		74,600		
152	British Columbia Electric Railway (*D*)					(o)	98,400	(o)	98,400	417,787,590	(o)	97,700		
153	Abitibi Electric Development Company, Ltd								43,105	281,557,016		42,557		
154	Great Lakes Power Company, Ltd									241,458,062				
155	Ottawa Valley Power Company						72,000		72,000	239,609,370		72,500		
156	The Nova Scotia Power Commission									216,227,296				
157	Southern Canada Power Company, Limited						47,200		44,400	203,264,130		46,800		
158	Montreal Island Power Company						45,000		45,000	193,833,300		41,220		
159	Calgary Power Company, Limited					(m)	44,500	(m)	37,600	144,956,182	(m)	44,500		
	Total for Canada									25,695,090,495				23,9
	Mexico													
160	The Mexican Light and Power Co., Ltd., and Subsidiaries					(o)	173,776	(o)	173,776	921,842,791	(o)	148,844		
	Electric Railways and Electrified Railroads													
161	Interborough Rapid Transit Company						296,220		296,220	1,158,592,929		302,180		1,1
162	Chicago Surface Lines									622,972,653				
163	Williamsburgh Power Plant Corp. (B.M.T.)					(o)	161,500	(o)	161,500	597,495,776	(o)	164,600		6
164	Pennsylvania Railroad Company					(o)	108,660	(o)	91,400	356,189,680	(o)	105,700		3
165	Philadelphia Rapid Transit Company						98,681			302,650,740		94,197		3
166	Boston Elevated Railway Company						81,270		81,270	224,417,750		79,380		2
167	New York Central R.R. Co.—Electric Division						78,200		65,200	220,871,582		73,700		2
168	New York, New Haven & Hartford Railroad Co.					(o)	44,000	(o)	23,100	164,550,700	(o)	41,800		1
169	St. Louis Public Service Company						43,000		6,400	141,028,510		43,100		1
170	Pacific Electric Railway Company						45,000			133,734,406				
171	Twin City Rapid Transit Company							(o)	41,925	124,673,675	(o)	38,085		1
172	Norfolk & Western Railway Co.						37,000		28,185	117,657,031		36,000		1
173	Chicago, Milwaukee, St. Paul & Pacific R.R. Co.									92,018,250				
	Total for Railways and Railroads									4,256,853,682				4,2

*Company names included in the 1934 table but omitted from this one follow, with the names under which their operations are now included in *italics*:

The Ohio Power Co.
Appalachian Electric Power Co.
Indiana & Michigan Electric Co.
Indiana General Service Co.
Wheeling Electric Co.
American Gas & Electric Co. Interconnected System

The North American Co. System (Mo. Ill. & Iowa Group)
Union Electric Light & Power Co.

The North American Co. System (Wis.-Mich. Group)
Milwaukee Elec. Ry. & Light Co., incl. Wis. E. P. Co., Wis. G. & E. Co., Wis. Mich. P. Co.

The North American Co. System (D. C. Group)
Potomac Electric Power Co.

The Connecticut Electric Service Co. System
The Connecticut Light & Power Co.

The Connecticut Company
Under 100,000,000 kw.-hr.

Illinois Power & Light Corporation
The Kansas Power & Light Company
Moline-Rock Island Manufacturin
The United Power & Light Corp.
No data were received from these

(*a*) Company practice varies as the peak is determined. Sin been requested on a 30-minu shorter period the returns h tered without comment. Th are noted. No distinction estimated and observed valu instantaneous and 30-minut

183,657,590	(o)	48,300	(o)	48,300	179,947,100	(o)	44,200	(o)	44,200	153,982,440	(o)	51,200	(o)	51,200	190,585,830		53,000	195,
180,575,000																		
169,705,134		36,356		34,515	152,802,616		34,428		25,858	153,647,061		39,311			171,071,489		42,500	175,
171,541,650	(o)	35,677	(o)	29,877	165,681,499		42,300		34,900	172,707,153		41,700		36,500	199,783,901	(m)	54,500	238,
155,229,322	(o)	31,000			141,135,632		34,000			132,689,604		39,000		0	178,076,358		45,000	232,
147,206,215		41,540		1,620	138,628,416		36,300			130,816,594		80,750		68,100	448,574,681		99,070	441,
159,272,880		38,300		27,800	159,327,841		39,100		26,800	142,240,346		39,815		18,815	149,093,897		43,220	143,
163,919,200																		
147,368,000		32,464			132,668,159		30,372			132,226,989		32,074			146,433,090		31,000	138,
153,002,823		33,000		33,000	143,553,046		28,200		28,200	127,731,492		27,840		24,600	143,522,953	(m)	35,630	178,
132,048,260																		
151,903,000		28,380		11,040	143,905,100		25,700		14,300	139,285,039		43,452		11,140	132,960,016		24,755	139,
140,332,635		28,000		8,700	130,082,544		28,200		20,500	126,841,303		29,640		2,840	147,896,790	(m)	31,390	146,
142,754,307					128,431,109					137,742,749		40,403		33,480	141,315,424			142,
136,293,181		28,825		28,825	126,074,818		31,225		31,225	125,997,054		32,000		32,000	134,821,422			
128,066,007		25,548			120,052,212		26,931			119,849,982		28,119		0	136,633,985		27,880	137,
132,627,390		26,800		35,600	134,761,462		26,710		39,000	124,824,746	(o)	25,130	(o)	41,750	123,216,441		40,000	129,
124,682,216	(o)	29,700			101,504,990	(o)	26,100	(o)	26,100	89,262,093		31,200			130,897,921		26,900	121,
118,862,965																		
120,909,429																		
105,600,712		23,300		23,300	95,226,852		26,700		26,700	98,446,191		25,800		25,800	109,489,363	(m)	25,300	103,
97,750,181	(o)	26,700	(o)	26,700	102,703,144	(o)	21,970	(o)	21,970	91,388,626	(o)	23,830	(o)	23,830	106,550,576			
106,306,878	(o)	22,134			104,019,804		25,305		4,620	103,725,735		26,783			118,526,461		27,912	115,
113,909,830	(o)	29,500	(o)	29,200	114,787,730	(o)	30,600	(o)	30,600	116,497,340	(o)	31,700	(o)	31,700	128,454,330		31,500	142,
109,335,038																		
98,138,150		18,681		100	90,238,272		20,030		101	93,796,831		22,387		77	112,918,808		23,1 4	114,
87,996,680																		
91,209,467																		
95,557,869		19,000		19,000	85,026,898		19,900		19,900	89,443,680		24,034		24,034	110,485,989		24,000	112,
93,527,800																		
87,676,238																		
196,009,181		43,600		43,600	178,667,276		40,000		40,000	177,656,470		42,000		42,000	185,041,631		42,500	183,
321,135,024					297,288,049					302,836,096		76,500		61,900	344,025,888		78,600	374,
98,370,102,676																		
6,443,023,189		1,082,000		690,000	4,990,727,444		828,280		527,420	4,221,001,199		915,945		699,630	4,387,316,157		937,320	5,077,
4,517,660,334		648,300		474,500	3,842,872,196		618,100		474,500	3,170,358,660		540,500			3,436,436,460	(m)	545,600	3,226,
2,755,875,028		490,289		489,589	2,689,161,650		503,705		503,005	2,527,827,765		485,775		485,075	2,414,375,792		450,000	2,525,
1,936,583,893		318,000		318,000	1,724,566,120		335,000		335,000	1,673,119,325		307,000		307,000	1,518,632,376		341,000	2,012,
1,807,484,405		335,600		126,000	1,529,382,839		274,000		127,000	1,249,312,710		285,150		142,700	1,557,929,949		310,000	1,650,
863,091,887		99,800		99,800	660,905,059		82,400		82,400	580,021,067		83,500		83,500	591,772,849		83,700	599,
938,873,577		122,000		122,000	455,089,497													
750,687,000		130,000		130,000	421,100,000													
554,214,300		97,500		97,500	487,213,500		126,850		126,850	518,856,200		132,700		132,700	614,665,600		119,750	598,
531,463,900		65,350		65,350	474,553,410		60,780		60,780	441,150,290		57,270		57,270	418,226,810		50,000	367,
549,530,695		98,900		93,331	508,256,900		94,600		89,287	486,799,830		89,100		85,845	412,080,147	(m)	89,223	414,
505,186,900				74,600	428,956,100			(o)	71,400	282,433,000				74,500	490,148,000			614,
396,538,400		99,200	(o)	98,100	389,102,000		100,600		98,000	405,750,100	(o)	100,800	(o)	100,800	425,510,139		100,200	437,
237,225,432		44,000		44,000	227,324,308		44,700		44,700	204,282,001								
224,878,662		30,702		30,702	173,949,572		20,500		20,500	153,646,054								
248,250,750		70,000		70,000	141,535,800													
217,312,316					199,952,617					159,428,487					173,924,966			151,
190,255,500		42,800		44,400	185,252,237		41,000		41,000	168,544,700		41,000		41,000	159,873,880	(m)	40,800	170,
168,188,870		45,300		45,300	135,786,020		40,950		40,950	172,307,040		44,250		44,250	146,048,890		41,000	105,
141,854,448		40,000		36,000	134,886,292		41,000		33,000	145,950,224		45,300		35,600	188,668,281		44,860	139,
23,978,179,486																		
824,977,559	(o)	129,626	(o)	129,626	725,351,101	(o)	124,035	(o)	124,035	691,485,448	(o)	122,907	(o)	122,907	691,150,190		121,485	681,
1,176,030,097		291,060		291,060	1,147,920,881		300,700		300,700	1,168,305,375		301,830		301,830	1,198,884,267		303,400	1,228,
578,818,638					594,098,027					354,922,052					595,733,093		197,574	624,
613,294,738	(o)	161,500	(o)	161,500	608,619,727	(o)	162,900	(o)	162,900	608,371,076	(o)	162,600	(o)	162,600	642,157,665		170,000	618,
355,947,402					284,602,140	(o)	99,060	(o)	78,300	291,426,822	(o)	105,430		95,600	330,309,340		86,800	343,
301,178,268		90,324			287,666,276		95,507			304,313,972		102,227		0	333,822,958		111,750	366,
224,327,000				79,695	220,340,490		93,030		93,030	244,678,940		98,490		98,490	257,065,945		103,194	(F) 270,
215,317,750				66,000	212,161,952		84,000		71,500	228,941,683		86,300		73,000	250,573,893		71,600	251,
163,719,900	(o)	41,200	(o)	26,400	154,300,000		43,000		26,600	179,000,000	(o)	42,800	(o)	28,900	213,400,000		43,000	225,
147,380,867		39,880		7,560	141,511,652		46,182		13,327	152,489,148		51,287		16,121	159,433,615		57,395	170,
131,149,744		40,000			133,094,054		47,000			143,901,864		48,000		0	157,888,334		48,000	169,
120,124,100	(o)	39,620	(o)	38,770	115,356,150	(o)	42,620	(o)	39,560	124,932,815	(o)	39,798	(o)	38,580	126,174,466		48,000	133,
113,301,507		32,650		21,500	103,837,503		29,500		21,540	99,938,196		34,300		27,300	116,745,039		24,000	132,
76,327,961					70,525,944					67,439,697					91,042,859			124,
4,216,917,972																		

turing Co.
Corp. (of Kansas)
these companies
s as to the period for which Since 1931 peak data have minute basis. For that or a rns have generally been en- . Those for a longer period ion has been made between values. In earlier years both inute peaks were called for. Detailed information for those years will be found in corresponding issues of the Supplement.

(b) Less energy supplied to other electric companies.

(c) Peaks refer to Kansas City system only.

(d) Excluding purchases for surplus sales to other electric corporations but including purchases to supplement output of generating stations for use of customers in Central Hudson territory.

(e) Over one-hour period. Excludes "Firm Peak Service" to Potomac Electric Power Co.

(f) Prior to 1932 Pennsylvania Water & Power Co. only.

(g) Includes "Firm Peak Service" to Potomac Electric Power Co.: in 1935 9,434,800 kw.-hr.; 1934 14,412,900; 1933 7,060,600.

(h) Sum of peaks of two divisions. 1935: Bridgeport 40,000, New Haven 38,700. 1934: each 35,000.

(j) Includes effect of supply to neighboring systems.

(m) Instantaneous or five-minute.

(n) Does not include purchased energy.

(o) Over one-hour period. Actual or estimated.

(p) A.-c. input. (r) Output measured on d.c. side.

(A) Energy produced from in output prior to 1932.

(B) Includes the Southern California Power Co. and during 1934 and 1935 we for redelivery.

(C) Canadian Niagara Pow included in Niagara Hud

(D) Mainland system only.

(E) Received too late for t

	(o) 46,500		197,482,000	(o) 45,100	189,445,000	(o) 40,000	(o) 40,000	169,672,488						
	(o) 48,400	(o) 48,400	196,171,710	(o) 48,000	183,657,590	(o) 48,300	(o) 48,300	179,947,100	(o) 44,200	(o) 44,200	153,982,44			
	(o) 50,655		191,918,000	(o) 50,635	180,575,000									
	(o) 43,779	(o) 41,355	179,573,314	(o) 41,893	169,705,134	36,356	34,515	152,802,616	34,428	25,858	153,647,06			
	(o) 38,262	(o) 28,762	178,991,700	(o) 42,167	171,541,650	(o) 35,677	(o) 29,877	165,681,499	42,300	34,900	172,707,15			
	(o) 40,000		177,678,245	(o) 34,200	155,229,322	(o) 31,000		141,135,632	34,000		132,689,60			
	41,150	12,200	177,112,090	36,100	147,206,215	41,540	1,620	138,628,416	36,300		130,816,59			
	(o) 52,640	(o) 38,640	169,874,630	(o) 54,860	159,272,880	38,300	27,800	159,327,841	39,100	26,800	142,240,34			
		39,350	168,594,800	38,100	163,919,200									
	(o) 37,618		164,465,000	(o) 35,030	147,368,000	32,464		132,668,159	30,372		132,226,98			
	36,600	36,600	154,575,830	34,800	153,002,823	33,000	33,000	143,553,046	28,200	28,200	127,731,49			
	38,650	38,650	153,917,750	34,400	132,048,260									
	38,500	11,000	147,737,000	40,200	151,903,000	28,380	11,040	143,905,100	25,700	14,300	139,285,03			
	38,200	20,000	147,493,112	32,400	140,332,635	28,000	8,700	130,082,544	28,200	20,500	126,841,30			
	42,120	30,515	146,820,606	39,115	142,754,307			128,431,109			137,742,74			
	32,505	32,505	144,433,133	30,065	136,293,181	28,825	28,825	126,074,818	31,225	31,225	125,997,05			
	29,265		142,732,398	25,989	128,066,007	25,548		120,052,212	26,931		119,849,98			
	(o) 24,660	(o) 42,800	131,135,733	(o) 25,120	132,627,390	26,800	35,600	134,761,462	26,710	39,000	124,824,74			
	(o) 28,100	(o) 28,100	128,469,723	(o) 27,500	124,682,216	(o) 29,700		101,504,990	(o) 26,100	(o) 26,100	89,262,09			
P. Co	29,720	20,620	125,266,928	28,200	118,862,965									
	25,500	25,500	123,564,750	26,200	120,909,429									
	29,000		122,754,775	25,500	105,600,712	23,300	23,300	95,226,852	26,700	26,700	98,446,19			
	25,510	25,510	120,090,871	25,350	97,750,181	(o) 26,700	(o) 26,700	102,703,144	(o) 21,970	(o) 21,970	91,388,62			
	(o) 26,373	(o) 5,009	118,302,350	(o) 23,010	106,306,878	(o) 22,134		104,019,804	25,305	4,620	103,725,73			
	(o) 30,000	29,600	115,642,930	28,400	113,909,830	(o) 29,500	(o) 29,200	114,787,730	(o) 30,600	(o) 30,600	116,497,34			
	24,600	28,800	114,213,818	23,270	109,335,038									
	(o) 24,256		113,953,970	(o) 20,899	98,138,150	18,681	100	90,238,272	20,030	101	93,796,83			
	30,050	30,050	107,685,118	22,345	87,996,680									
	(m) 28,000	(m) 28,000	105,157,090	(m) 23,000	91,209,467									
	(m) 23,500	(m) 23,500	103,776,867	(m) 22,000	95,557,869	19,000	19,000	85,026,898	19,900	19,900	89,443,68			
	(m) 25,500	(m) 25,500	103,750,200	(m) 24,800	93,527,800									
	24,000		103,563,210		87,676,238									
		45,000	206,358,724	44,000	196,009,181	43,600	43,600	178,667,276	40,000	40,000	177,656,47			
	82,150	81,450	360,488,633	72,100	321,135,024			297,288,049			302,836,09			
			102,894,925,190		98,370,102,676									
	1,319,000	872,000	6,954,453,468	1,215,000	6,443,023,189	1,082,000	690,000	4,990,727,444	828,280	527,420	4,221,001,19			
	829,100	590,900	4,777,711,082	788,400	4,517,660,334	648,300	474,500	3,842,872,196	618,100	474,500	3,170,358,66			
	484,534	483,684	2,843,388,706	493,561	2,755,875,028	490,289	489,589	2,689,161,650	503,705	503,005	2,527,827,76			
		(o) 363,000	2,220,640,856		1,936,583,893	318,000	318,000	1,724,566,120	335,000	335,000	1,673,119,32			
	426,700	156,000	2,071,625,524	362,250	1,807,484,405	335,600	126,000	1,529,382,839	274,000	127,000	1,249,312,71			
		121,400	916,891,229	115,000	863,091,887	99,800	99,800	660,905,059	82,400	82,400	580,021,06			
	160,000	160,000	832,239,594	160,000	938,873,577	122,000	122,000	455,089,497						
	222,200	222,200	825,901,000	172,200	750,687,000	130,000	130,000	421,100,000						
	145,300		657,958,100	110,900	554,214,300	97,500	97,500	487,213,500	126,850	126,850	518,856,20			
	79,200	64,800	577,265,540	72,700	531,463,900	65,350	65,350	474,553,410	60,780	60,780	441,150,29			
	95,500	90,883	552,752,450	96,200	549,530,695	98,900	93,331	508,256,900	94,600	89,287	486,799,83			
		74,600	525,570,000	74,600	505,186,900		74,600	428,956,100		(o) 71,400	282,433,00			
	(o) 98,400	(o) 98,400	417,787,590	(o) 97,700	396,538,400	99,200	(o) 98,100	389,102,000	100,600	98,000	405,750,10			
		43,105	281,557,016	42,557	237,225,432	44,000	44,000	227,324,308	44,700	44,700	204,282,00			
			241,458,062		224,878,662	30,702	30,702	173,949,572	20,500	20,500	153,646,05			
	72,000	72,000	239,609,370	72,500	248,250,750	70,000	70,000	141,535,800						
			216,227,296		217,312,316			199,952,617			159,428,48			
	47,200	44,400	203,264,130	46,800	190,255,500	42,800	44,400	185,252,237	41,000	41,000	168,544,70			
	45,000	45,000	193,833,300	41,220	168,188,870	45,300	45,300	135,786,020	40,950	40,950	172,307,04			
	(m) 44,500	(m) 37,600	144,956,182	(m) 44,500	141,854,448	40,000	36,000	134,886,292	41,000	33,000	145,950,22			
			25,695,090,495		23,978,179,486									
	(o) 173,776	(o) 173,776	921,842,791	(o) 148,844	824,977,559	(o) 129,626	(o) 129,626	725,351,101	(o) 124,035	(o) 124,035	691,485,44			
	296,220	296,220	1,158,592,929	302,180	1,176,030,097	291,060	291,060	1,147,920,881	300,700	300,700	1,168,305,37			
			622,972,653		578,818,638			594,098,027			354,922,05			
	(o) 161,500	(o) 161,500	597,495,776	(o) 164,600	613,294,738	(o) 161,500	(o) 161,500	608,619,727	(o) 162,900	(o) 162,900	608,371,07			
	(o) 108,660	(o) 91,400	356,189,680	(o) 105,700	355,947,402			284,602,140	(o) 99,060	(o) 78,300	291,426,82			
	98,681		302,650,740	94,197	301,178,268	90,324		287,666,276	95,507		304,313,97			
	81,270	81,270	224,417,750	79,380	224,327,000		79,695	220,340,490	93,030	93,030	244,678,94			
	78,200	65,200	220,871,582	73,700	215,317,750		66,000	212,161,952	84,000	71,500	228,941,68			
	(o) 44,000	(o) 23,100	164,550,700	(o) 41,800	163,719,900	(o) 41,200	(o) 26,400	154,300,000	43,000	26,600	179,000,00			
	43,000	6,400	141,028,510	43,100	147,380,867	39,880	7,560	141,511,652	46,182	13,327	152,489,14			
	45,000		133,734,406		131,149,744	40,000		133,094,054	47,000		143,901,86			
		(o) 41,925	124,673,675	(o) 38,085	120,124,100	(o) 39,620	(o) 38,770	115,356,150	(o) 42,620	(o) 39,560	124,932,81			
	37,000	28,185	117,657,031	36,000	113,301,507	32,650	21,500	103,837,503	29,500	21,540	99,938,19			
			92,018,250		76,327,961			70,525,944			67,439,69			
			4,256,853,682		4,216,917,972									

can Co. System (Wis.-Mich. Group)
Ry. & Light Co., incl. Wis. E. P. Co., Co., Wis. Mich. P. Co.
can Co. System (D. C. Group)
Power Co.
Electric Service Co. System
Light & Power Co.
Company
000 kw.-hr.
ight Corporation
r & Light Company
Moline-Rock Island Manufacturing Co.
The United Power & Light Corp. (of Kansas)
No data were received from these companies

(a) Company practice varies as to the period for which the peak is determined. Since 1931 peak data have been requested on a 30-minute basis. For that or a shorter period the returns have generally been entered without comment. Those for a longer period are noted. No distinction has been made between estimated and observed values. In earlier years both instantaneous and 30-minute peaks were called for. Detailed information for those years will be found in corresponding issues of the Supplement.

(b) Less energy supplied to other electric companies.

(c) Peaks refer to Kansas City system only.

(d) Excluding purchases for surplus sales to other electric corporations but including purchases to supplement output of generating stations for use of customers in Central Hudson territory.

(e) Over one-hour period. Excludes "Firm Peak Service" to Potomac Electric Power Co.

(f) Prior to 1932 Pennsylvania Water & Power Co. only.

(g) Includes "F
Power Co.:
900; 1933 7,

(h) Sum of pea
40,000, New

(j) Includes effe

(m) Instantaneo

(n) Does not in

(o) Over one-ho

(p) A.-c. input.

32,440	(o)	51,200	(o)	51,200	190,585,830		53,000	195,295,900		58,000	219,020,744				109
47,061		39,311			171,071,489		42,500	175,304,555		40,500	162,477,080				110
07,153		41,700		36,500	199,783,901	(m)	54,500	238,979,012		51,600	238,200,935				111
89,604		39,000		0	178,076,358		45,000	232,425,592							112
16,594		80,750		68,100	448,574,681		99,070	441,309,468		93,170	424,300,963		84,205	383,337,429	113
40,346		39,815		18,815	149,093,897		43,220	143,380,401		41,940	144,364,260		30,200	114,835,060	114
															115
26,989		32,074			146,433,090		31,000	138,781,877		25,508	103,748,759				116
31,492		27,840		24,600	143,522,953	(m)	35,630	178,992,370		33,000	170,887,397	(m)	31,720	152,885,453	117
															118
35,039		43,452		11,140	132,960,016		24,755	139,618,715							119
41,303		29,640		2,840	147,896,790	(m)	31,390	146,368,000	(m)	23,620	145,405,000	(m)	26,480	122,579,000	120
42,749		40,403		33,480	141,315,424			142,532,297							121
97,054		32,000		32,000	134,821,422										122
49,982		28,119		0	136,633,985		27,880	137,457,239		29,700	134,571,700		23,500	122,337,055	123
24,746	(o)	25,130	(o)	41,750	123,216,441		40,000	129,087,117		26,810	115,530,335				124
62,093		31,200			130,897,921		26,900	121,419,692		29,440	136,213,088				125
															126
															127
46,191		25,800		25,800	109,489,363	(m)	25,300	103,891,909							128
88,626	(o)	23,830	(o)	23,830	106,550,576										129
25,735		26,783			118,526,461		27,912	115,634,958		30,300	116,745,731		23,400	93,469,303	130
97,340	(o)	31,700	(o)	31,700	128,454,330		31,500	142,486,580		31,800	128,665,860		28,100	117,999,180	131
															132
96,831		22,387		77	112,918,808		23,1 4	114,480,898		23,065	111,870,280				133
															134
															135
43,680		24,034		24,034	110,485,989		24,000	112,612,701							136
															137
															138
56,470		42,000		42,000	185,041,631		42,500	183,658,907		42,500	172,539,101		36,000	150,666,072	139
36,096		76,500		61,900	344,025,888		78,600	374,997,370		82,800	388,871,320		76,600	356,228,046	139a
01,199		915,945		699,630	4,387,316,157		937,320	5,077,430,835		847,710	5,071,853,732		794,430	4,429,404,096	140
58,660		540,500			3,436,436,460	(m)	545,600	3,226,014,549	(m)	538,300	3,726,436,341		532,945	3,409,717,522	141
27,765		485,775		485,075	2,414,375,792		450,000	2,525,560,158		387,000	2,090,788,460		280,000	1,297,239,606	142
19,325		307,000		307,000	1,518,632,376		341,000	2,012,869,376		351,000	2,093,829,000		315,000	2,096,903,000	143
12,710		285,150		142,700	1,557,929,949		310,000	1,650,636,536	(m)	292,020	1,568,864,226	(m)	279,250	1,450,484,998	144
21,067		83,500		83,500	591,772,849		83,700	599,257,403		74,800	539,626,687		39,700	516,071,474	145
															146
															147
56,200		132,700		132,700	614,665,600		119,750	598,508,500		124,200	703,982,200		129,000	654,491,510	148
50,290		57,270		57,270	418,226,810		50,000	367,130,780		46,000	347,797,680		45,000	343,930,010	149
99,830		89,100		85,845	412,080,147	(m)	89,223	414,195,787	(m)	73,400	445,579,835		74,940	400,668,600	150
33,000				74,500	490,148,000			614,411,500			632,261,900			621,423,800	151
50,100	(o)	100,800	(o)	100,800	425,510,139		100,200	437,731,126		94,000	418,075,320		94,600	390,564,500	152
82,001															153
46,054															154
															155
28,487					173,924,966			151,414,019							156
44,700		41,000		41,000	159,873,880	(m)	40,800	170,619,052		31,000	149,105,920	(m)	31,700	146,233,060	157
07,040		44,250		44,250	146,048,890		41,000	105,805,180							158
50,224		45,300		35,600	188,668,281		44,860	139,302,262	(m)	29,500	126,876,336	(m)	26,100	104,577,805	159
85,448	(o)	122,907	(o)	122,907	691,150,190		121,485	681,822,792		111,140	641,828,127	(m)	107,608	628,832,675	160
05,375		301,830		301,830	1,198,884,267		303,400	1,228,301,211		304,460	1,217,047,463		298,760	1,177,155,819	161
22,052					595,733,093		197,574	624,776,062		200,698	(p) 664,908,358		195,730	(r) 592,545,223	162
71,076	(o)	162,600	(o)	162,600	642,157,665		170,000	618,219,724		159,000	599,442,974		150,000	568,889,703	163
26,822	(o)	105,430		95,600	330,309,340		86,800	343,354,637		89,800	343,646,828		87,700	333,037,210	164
13,972		102,227		0	333,822,958		111,750	366,341,403		116,162	384,076,148		110,071	377,326,475	165
78,940		98,490		98,490	257,065,945		103,194	(F) 270,054,975		91,403	247,473,090		91,576	252,965,140	166
41,683		86,300		73,000	250,573,893		71,600	251,780,404		75,400	247,599,220		68,280	230,003,185	167
00,000	(o)	42,800	(o)	28,900	213,400,000		43,000	225,941,425		41,600	209,370,023		40,750	201,191,225	168
89,148		51,287		16,121	159,433,615		57,395	170,343,455							169
01,864		48,000		0	157,888,334		48,000	169,134,719		48,000	182,813,761		48,000	184,759,206	170
32,815	(o)	39,798	(o)	38,580	126,174,466		48,000	133,337,207		49,732	140,190,412		46,865	135,530,869	171
38,196		34,300		27,300	116,745,039		24,000	132,339,094		30,000	134,368,264		30,000	127,944,156	172
39,697					91,042,859			124,593,517			156,186,340			162,274,409	173

es "Firm Peak Service" to Potomac Electric Co.: in 1935 9,434,800 kw.-hr.; 1934 14,412,-933 7,060,600.

f peaks of two divisions. 1935: Bridgeport New Haven 38,700. 1934: each 35,000.

es effect of supply to neighboring systems.

aneous or five-minute.

ot include purchased energy.

ne-hour period. Actual or estimated.

put. (r) Output measured on d.c. side.

(A) Energy produced from "Water Sold" was included in output prior to 1932. See Suppl., May 6, 1933.

(B) Includes the Southern Sierras Power Co., Nevada-California Power Co. and Yuma Utilities Co. Peaks during 1934 and 1935 were read during through-feed for redelivery.

(C) Canadian Niagara Power Co., Ltd., (see Canada), included in Niagara Hudson Power Corp. System.

(D) Mainland system only.

(E) Received too late for tabulation in proper order.

(F) A.-c. output. Prior to 1930 the output given is kw.-hr. generated as d.c. or after conversion to d.c.

(H) For companies included in various earlier years see Supplement, May 5, 1934.

(J) Includes Manitoba Power Co., Ltd., Suburban Rapid Transit Co., Winnipeg Selkirk & Lake Winnipeg Ry., Northwestern Power Corp., Ltd. For earlier years see Supplement, May 5, 1934.

(L) Operations since 1932 not comparable with earlier years. See Supplement, May 6, 1933.

For explanations and comments relating to these statistics the *Electrical World* of May 9, 1936, should be consulted.

The table includes one company retained from previous lists although its output in 1935 fell short of 100,000,000 kw.-hr.

Table II—Detailed Data on Ge of Public Utility Systems Hav

Line No.	Section and System	Generator Rating, Dec. 31, 1935				Generated and Purchased Output, 1935			
		Fuel Burning Plants		Hydro Plants					
		No. of Plants	Rating of Generators, Kw.	No. of Plants	Rating of Generators, Kw.	Total Output, Kw.-Hr.	Generated (Net), Kw.-Hr.	Purchased, Kw.-Hr.	Farm or Rural, if not Included in Domestic
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	New England States								
1	New England Power Assn. and Subsidiary Cos	18	412,050	27	337,930	2,188,886,998	1,695,453,584	493,433,414	987,932
2	The Edison Electric Illuminating Co. of Boston	2	367,860	1	L 50	1,224,562,906	1,000,086,465	224,476,441	3,814,561
3	The Connecticut Light and Power Company	2	107,500	14	58,190	632,021,404	410,449,593	221,571,811	
4	Constituent Utility Cos. of Western Mass. Cos	3	L 62,000	9	L 89,825	460,014,000	332,515,000	127,499,000	
5	Central Maine Power Company	3	13,572	25	108,814	459,905,610	437,043,023	22,862,587	
6	Montaup Electric Company	1	73,000	0	0	423,657,024	402,649,990	21,007,034	
7	Hartford Electric Light Company	2	126,000	1	750	341,336,209	346,880,920	b —5,544,711	
8	The United Illuminating Company	2	155,000	0	0	308,338,000	308,338,000		
9	Public Service Company of New Hampshire	5	43,570	23	40,779	219,205,635	197,250,513	21,955,122	3,821,491
10	Blackstone Valley Gas & Electric Company	1	33,500	3	1,750	213,154,659	8,365,792	204,788,867	481,552
11	New Bedford Gas & Edison L't Co. (Assoc. G. & E. Sys.)	1	92,000	0	0	196,171,710	196,171,710		594,892
12	Cumberland County Power and Light Co.	2	45,125	8	32,217	169,874,630	139,900,630	29,974,000	2,192,676
13	The Connecticut Power Company	0	0	2	f 9,600	147,737,000	36,266,000	111,471,000	
14	Bangor Hydro-Electric Company	0	0	12	31,035	120,090,871	120,034,371	56,500	
	Totals for section	42	1,531,177	125	710,940	7,104,956,656	5,631,405,591	1,473,551,065	
	Middle Atlantic States								
15	Niagara Hudson Power Corporation (*e*)	8	L 640,650	100	L 1,038,562	7,063,367,862	5,851,207,177	1,212,160,685	27,422,822
16	Consolidated Gas Co. of N. Y., Elec. Cos. Affil. with the	8	2,348,200	0	0	5,493,400,000	4,587,500,000	905,900,000	
17	Philadelphia Electric Company System	9	871,110	3	253,765	3,210,338,623	3,243,825,173	—33,486,550	
18	Public Service Electric and Gas Company (N. J.)	5	684,450	0	0	2,269,424,555	2,024,524,364	244,900,191	
19	The West Penn Electric Co. & Subsidiary Cos	29	449,948	11	56,375	2,068,152,932	2,029,007,611	39,145,321	
20	Pennsylvania Power & Light Company	19	311,752	21	45,135	1,522,748,500	1,315,115,400	207,633,100	10,950,800
21	Pennsylvania Wtr. & Pwr. Co. and Safe Harbor Wtr. Pwr. Corp.	1	20,000	2	291,000	1,429,694,400	1,419,049,800	10,644,600	
22	Duquesne Light Company	4	444,000	0	0	1,403,252,940	1,386,364,970	16,887,970	
23	Assoc. Gas & Elec. System (Eastern Pa. & N. J. Group)	4	219,000	5	22,198	795,377,813	637,864,222	157,513,591	8,347,639
24	N. Y. State Elec. & Gas Corp. Group (Assoc. G. & E. Sys.)	7	56,510	22	14,155	505,251,769	266,177,323	239,074,446	11,973,699
25	Assoc. Gas & Elec. System (West. Penna. Group)	9	92,436	2	48,000	400,303,230	393,373,524	6,929,706	3,525,055
26	Rochester Gas & Elec. Corp. (Assoc. G. & E. System)	6	83,975	12	48,645	384,512,454	237,386,080	147,126,374	4,144,595
27	Long Island Lighting Company System	10	168,750	0	0	283,939,361	283,930,812	8,549	
28	The Scranton Electric Company	4	m 119,500	0	0	276,436,132	275,075,344	1,360,788	136,302
29	Penn Central Light and Power Co. (Assoc. G. & E. System)	3	76,100	3	4,520	253,756,501	252,785,528	970,973	1,133,904
30	Jersey Central Power and Light Company	5	141,300	1	350	242,095,275	318,921,795	n —76,826,520	
31	Atlantic City Electric Company	2	o 120,000	0	0	223,614,768	223,338,768	276,000	4,136,200
32	Central Hudson Gas & Electric Corporation	1	12,000	6	23,740	216,374,355	85,581,974	130,792,381	6,475,225
33	Pennsylvania Power Company	0	0	0	0	177,678,245	0	177,678,245	2,416,627
34	Luzerne County Gas & Electric Corp	2	55,000	0	0	131,135,733	214,212,880	—83,077,147	30,648
35	Staten Island Edison Corp. (Assoc. G. & E. System)	1	47,500	0	0	115,642,930	112,189,430	3,453,500	112,578
	Totals for section (*e*)	137	6,962,181	188	1,846,445	28,466,498,378	25,157,432,175	3,309,066,203	
	East North Central States								
36	Commonwealth Edison Company	4	874,500	0	0	4,191,045,000	2,110,284,000	p 2,080,761,000	2,000
37	American Gas & Electric Co. Interconnected System	25	s 862,320	17	103,344	3,819,332,352	3,624,762,827	194,569,525	13,932,853
38	The Detroit Edison Company	7	801,925	8	L 9,550	2,534,561,100	2,526,298,900	8,262,200	12,598,000
39	Public Service Co. of Northern Illinois	5	342,000	2	800	1,696,756,840	927,366,384	769,390,456	9,059,847
40	The Cleveland Electric Illuminating Company	4	477,500	0	0	1,457,969,255	1,457,887,679	81,576	5,009,403
41	Super-Power Co. of Illinois	1	t 215,000	0	0	1,346,251,000	1,346,198,600	52,400	
42	Columbia Gas & Electric Corp. & Subsidiary Cos	5	381,750	0	0	1,252,490,212	1,257,012,770	b —4,522,558	
43	Consumers Power Company	6	L 255,500	43	L 147,810	1,233,811,914	1,130,463,418	103,348,496	12,789,374
44	The Milwaukee Elec. Ry. & Light Co. & Affil. Cos. (*D*)	u 10	499,764	u 10	19,705	1,210,496,055	1,097,535,213	112,960,842	
45	Chicago District Electric Generating Corp	1	200,000	0	0	1,168,934,000	1,168,934,000		
46	Ohio Edison Company	5	L 311,500	1	L 1,950	876,899,592	844,906,175	31,993,417	5,851,454
47	Public Service Company of Indiana	7	L 120,430	2	4,290	642,607,543	555,802,282	86,805,261	3,005,243
48	The Toledo Edison Company	4	160,180	1	5,000	492,963,903	308,178,003	184,785,900	1,486,905
49	Northern Indiana Public Service Company	3	L 96,100	7	L 1,635	463,600,194	408,795,586	54,804,608	2,651,472
50	The Ohio Public Service Company	8	130,100	0	0	453,088,903	380,248,083	72,840,820	4,200,694
51	Central Illinois Public Service Company	5	81,140	0	0	368,717,938	184,140,295	184,577,643	4,226,560
51a	Indianapolis Power & Light Company	4	166,700	0	0	360,488,633	305,655,046	54,833,587	
52	The Columbus Railway, Power and Light Co	6	132,500	0	0	316,027,352	314,984,150	1,043,202	
53	Central Illinois Light Company	4	88,500	0	0	291,344,894	286,515,944	4,828,950	1,436,412
54	Wisconsin Power and Light Company	6	49,604	31	37,313	287,192,562	256,851,165	30,341,397	6,871,617
55	Wisconsin Public Service Corporation	5	42,900	18	45,232	258,398,400	246,347,796	12,050,604	
56	City of Detroit, Public Lighting Commission	1	80,000	0	0	203,623,520	185,116,000	18,507,520	0
57	Northern Indiana Power Company	10	23,000	2	384	177,112,090	1,529,348	175,582,742	2,058,298
58	City of Cleveland, Department of Public Utilities	1	50,000	0	0	168,594,800	168,594,800	0	
59	Indiana Service Corporation	1	31,000	0	0	147,493,112	45,354,800	102,138,312	1,191,122

Supplement to ELECTRICAL WORLD, May 9, 1936
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Generator Rating, Output, Customers and Distribution of En
aving an Output Exceeding 100,000,000 Kw.-Hr. During

	Distribution of Output in Kilowatt-Hours, 1935									Number of			
n	Domestic Service (11)	Commercial Small Light and Power (Retail) (12)	Commercial Large Light and Power (Wholesale) (13)	Municipal Service (Street Lighting, etc.) (14)	Other Sales to Ultimate Consumers (15)	Elec. R'way Operation (Including Company-Owned) (16)	Other Public Utilities (Including Municipal Systems) (17)	Used by Company (18)	Not Accounted for (Losses) (19)	Farm or Rural if Not Included in Domestic (20)	Domestic (21)	Commercial Small Light and Power (Retail) (22)	Con Lar and (W
2	213,948,517	133,939,491	736,194,163	40,181,182		56,024,169	669,590,760	47,767,858	290,252,926	450	415,531	60,040	
1	197,004,500	188,554,250	300,762,404	32,140,876		20,697,801	308,076,362	5,410,807	168,101,345	*a* 2,124	*a* 317,958	*a* 68,740	*a*
..	95,694,821	39,997,949	247,523,333	10,079,126		35,600,510	122,691,789	16,721,323	63,712,553		131,099	17,282	
..	50,052,000	38,433,000	142,818,000	9,349,000	*l* 4,859,000	18,930,000	118,669,000	5,301,000	71,603,000		*k* 73,426	*k* 12,625	*k*
..	35,261,998	20,184,983	237,946,517	9,624,586		4,721,340	36,413,528	47,471,578	68,281,080		65,777	10,738	
..							423,657,024						
..	56,819,074	63,008,954	52,646,341	7,377,600	0	18,100,800	105,544,868	3,681,867	34,156,705		62,491	9,802	
..	57,682,882	53,012,295	138,075,660	7,543,732			7,495,000	4,078,499	40,449,932		106,758	14,852	
1	21,405,142	13,938,104	56,374,879	6,228,310		3,901,593	81,494,132	4,646,124	27,395,860	5,512	42,817	7,354	
2	17,198,906	13,831,818	128,960,110	9,889,418			23,109,987	1,033,720	18,649,148	265	41,640	5,181	
2	13,775,302	8,582,894	123,330,656	3,802,324			25,931,698	2,343,994	17,809,950	497	35,744	4,812	
6	20,739,945	34,105,908	54,593,830	4,426,952		11,912,366	13,763,600	2,984,842	25,154,511	4,037	36,378	8,271	
..	16,797,000	7,468,000	25,326,000	1,605,000		0	89,341,000	854,000	6,346,000		*a* 19,667	*a* 3,031	*a*
..	17,478,999	(*d*)	*d* 75,874,733	1,121,614		3,052,350	2,892,410	590,234	19,080,531		26,159	(*f*)	*t*
2	417,628,874	363,738,919	3,466,266,512	107,312,249		112,077,769	1,572,648,787	50,368,848	945,903,082	28,992	554,619	82,647	
..	895,500,000	(*d*)	*d* 2,988,700,000	286,000,000		470,700,000		37,000,000	815,500,000		*a* 1,848,378	(*d*)	*a d*
..	385,545,268	317,424,182	1,262,004,028	31,438,395		677,086,990	143,271,120	29,314,073	364,254,567		549,825	112,662	
..	392,001,921	498,891,351	835,136,356	60,164,777		*h* 119,197,263	1,726,880	22,968,282	339,337,725		733,670	156,307	
..	187,092,150	138,069,989	1,390,489,802	20,821,937	5,774,172	64,733,943	9,140,560		252,030,379		275,146	47,502	
0	155,660,800	(*d*)	*d* 1,041,912,000	55,676,900			73,055,800		185,492,200	11,659	295,055	(*d*)	*d*
..							1,358,327,500		71,366,900				
..	223,442,705	110,024,685	711,302,659	28,976,480		174,482,790	4,290,945	4,064,892	146,667,784		287,746	28,958	
9	69,362,783	45,840,657	363,250,337	12,190,022		22,441,472	156,134,341	12,728,254	105,082,308	6,791	121,742	19,843	
9	80,084,753	41,882,014	184,612,768	22,633,266		1,067,496	95,836,265	3,274,687	63,886,821	13,055	119,279	18,575	
5	47,170,768	31,526,841	195,963,574	11,216,804		3,192,132	35,148,105	3,801,292	68,758,659	5,038	93,500	13,644	
5	60,810,390	78,897,513	103,757,307	31,523,822		29,083,799	1,795,860	18,124,176	56,374,992	5,642	105,621	12,194	
..	85,572,007	36,468,508	60,163,712	21,093,110	134,263	14,048,000	2,029,022	6,185,828	58,244,911		126,765	17,478	
2	34,678,357	36,462,637	141,977,162	5,247,116		13,663,210	9,256,922	1,019,481	33,994,945	94	68,073	10,577	
4	28,531,829	17,171,524	121,308,510	5,868,584		9,757,412	31,895,122	3,365,176	34,724,440	1,722	49,351	8,068	
..	50,932,814	21,940,961	78,507,104	22,580,707	420,460	12,303,610	5,074,740	7,618,228	42,716,651		76,903	11,444	
0	40,577,466	55,208,892	73,678,866	8,432,866		135,148	2,611,000	2,696,372	36,137,958	4,145	66,852	14,886	
5	36,341,538	31,612,727	54,072,458	5,543,470		867,000	42,179,481	5,100,401	34,182,055	4,200	52,172	12,005	
7	20,710,419	18,969,032	110,939,972	2,959,986		2,979,260	5,310,360		13,392,589	2,497	34,218	5,461	
8	14,260,466	7,543,871	83,348,778	2,614,853		8,628,843	830,420	1,667,718	12,210,136	45	32,231	3,684	
8	24,802,606	9,090,660	35,924,988	11,690,872		14,304,283	3,147,300	1,457,157	15,112,486	103	38,732	5,367	
0	604,209,000	468,276,000	1,570,505,000	111,116,000	25,000	853,648,000	*i* 31,598,000	21,173,000	530,493,000	5	*r* 807,556	120,710	
3	259,740,047	253,647,988	2,225,721,836	26,182,865		40,191,996	569,438,613	16,818,879	413,657,275	17,230	421,884	80,760	
0	*j* 362,339,000	462,607,100	1,177,309,900	52,352,200		68,706,300	92,891,600	24,069,700	281,687,300	18,928	*j* 489,894	76,127	
7	162,346,463	95,492,248	312,559,664	97,564,088		80,206,341	756,823,581	12,940,149	169,764,459	10,010	237,093	31,498	
3	204,184,957	160,132,183	699,017,791	18,708,537	31,765,059	133,425,760	14,583,800	6,194,344	184,947,421	5,789	271,005	32,043	
..							1,346,251,000						
..	192,308,570	131,803,432	501,502,772	66,845,119		105,983,295	94,237,249	18,319,129	141,490,646		280,970	39,178	
4	195,738,220	189,463,207	567,357,293	18,870,166		9,483,865	20,414,735	12,297,960	207,397,094	18,460	272,600	51,737	
..	221,475,256	145,809,586	473,789,633	29,262,368	3,141,992	112,891,969	33,881,266	12,352,211	177,891,774		275,825	46,038	
							1,168,934,000						
4	112,124,805	123,629,995	274,339,999	13,371,614		28,612,625	216,377,149	4,784,081	97,807,870	6,571	152,677	21,779	
3	51,144,101	40,639,418	160,830,524	7,893,862	10,653,010	61,535,792	204,224,874	5,131,348	97,549,371	4,957	99,639	18,249	
5	48,785,194	48,192,099	252,076,657	10,448,986		41,248,598	25,944,142	3,199,570	61,581,752	2,589	83,608	10,873	
2	33,565,053	20,691,937	181,205,743	12,936,787		28,451,521	103,535,467	10,370,898	70,191,316	3,557	61,234	10,563	
4	44,068,243	38,366,386	240,739,096	6,760,156		1,532,956	63,261,298	2,381,762	51,778,312	5,365	66,107	10,804	
0	49,785,657	54,372,157	107,531,850	18,549,858			53,638,925	16,828,247	63,784,684	3,825	111,067	27,338	
..	61,346,384	81,887,851	153,082,245	17,511,767			1,675,631	6,496,533	38,488,222		99,028	12,288	
..	55,499,624	43,587,899	99,794,350	2,102,536	628,266	25,257,220	61,939,200	1,824,243	25,394,014		87,692	10,605	
2	34,251,165	52,860,999	163,758,752	4,798,094		1,777,510	3,363,141	1,350,302	27,748,519	1.940	46,745	10,771	
7	36,983,166	24,848,905	43,721,814	6,728,344	3,516,163	1,750,380	106,574,740	5,418,854	50,778,579	9,412	69,002	13,019	
..	35,201,416	26,260,834	107,325,852	7,298,503			32,843,077	5,681,948	43,786,770		61,622	9,675	
0	0	163,647	11,881,966	84,924,291	0	92,472,560	0		14,181,056	0	0	12	
8	16,843,389	13,961,589	80,369,487	2,129,186	2,385,179	650,010	17,160,980	2,177,649	39,376,323	3,230	39,035	7,849	
..	29,665,509	27,223,877	45,048,910	41,081,830			3,403,692		22,170,982		44,148	7,326	
2	9,686,456	13,930,865	70,924,972	2,416,020		8,461,042	14,134,620	13,364,219	13,383,796	2,283	17,013	2,936	

58	City of Cleveland, Department of Public Utilities	1	50,000	0	0	168,594,800	168,594,800	0					
59	Indiana Service Corporation	1	31,000	0	0	147,493,112	45,354,800	102,138,312	1,191,122				

Supplement to ELECTRICAL WORLD, May 9, 1936

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II—Detailed Data on Generator Rating, Output, Customer
blic Utility Systems Having an Output Exceeding 100,00

1935		Generated and Purchased Output, 1935			Distribution of Output in Kilowatt-Hours, 1935								
Plants	ating of nerators, Kw. (6)	Total Output, Kw.-Hr. (7)	Generated (Net), Kw.-Hr. (8)	Purchased, Kw.-Hr. (9)	Farm or Rural, if not Included in Domestic (10)	Domestic Service (11)	Commercial Small Light and Power (Retail) (12)	Commercial Large Light and Power (Wholesale) (13)	Municipal Service (Street Lighting, etc.) (14)	Other Sales to Ultimate Consumers (15)	Elec. R'way Operation (Including Company-Owned) (16)	Other Public Utilities (Including Municipal Systems) (17)
	337,930	2,188,886,998	1,695,453,584	493,433,414	987,932	213,948,517	133,939,491	736,194,163	40,181,182		56,024,169	669,590,760
	50	1,224,562,906	1,000,086,465	224,476,441	3,814,561	197,004,500	188,554,250	300,762,404	32,140,876		20,697,801	308,076,362
	58,190	632,021,404	410,449,593	221,571,811		95,694,821	39,997,949	247,523,333	10,079,126		35,600,510	122,691,789
	89,825	460,014,000	332,515,000	127,499,000		50,052,000	38,433,000	142,818,000	9,349,000	*l* 4,859,000	18,930,000	118,669,000
	108,814	459,905,610	437,043,023	22,862,587		35,261,998	20,184,983	237,946,517	9,624,586		4,721,340	36,413,528
	0	423,657,024	402,649,990	21,007,034								423,657,024
	750	341,336,209	346,880,920	*b* —5,544,711		56,819,074	63,008,954	52,646,341	7,377,600	0	18,100,800	105,544,868
	0	308,338,000	308,338,000			57,682,882	53,012,295	138,075,660	7,543,732			7,495,000
	40,779	219,205,635	197,250,513	21,955,122	3,821,491	21,405,142	13,938,104	56,374,879	6,228,310		3,901,593	81,494,132
	1,750	213,154,659	8,365,792	204,788,867	481,552	17,198,906	13,831,818	128,960,110	9,889,418			23,109,987
	0	196,171,710	196,171,710		594,892	13,775,302	8,582,894	123,330,656	3,802,324			25,931,698
	32,217	169,874,630	139,900,630	29,974,000	2,192,676	20,739,945	34,105,908	54,593,830	4,426,952		11,912,366	13,763,600
	9,600	147,737,000	36,266,000	111,471,000		16,797,000	7,468,000	25,326,000	1,605,000		0	89,341,000
	31,035	120,090,871	120,034,371	56,500		17,478,999	(*d*)	*d* 75,874,733	1,121,614		3,052,350	2,892,410
	710,940	7,104,956,656	5,631,405,591	1,473,551,065								
	,038,562	7,063,367,862	5,851,207,177	1,212,160,685	27,422,822	417,628,874	363,738,919	3,466,266,512	107,312,249		112,077,769	1,572,648,787
	0	5,493,400,000	4,587,500,000	905,900,000		895,500,000	(*d*)	*d* 2,988,700,000	286,000,000		470,700,000	
	253,765	3,210,338,623	3,243,825,173	—33,486,550		385,545,268	317,424,182	1,262,004,028	31,438,395		677,086,990	143,271,120
	0	2,269,424,555	2,024,524,364	244,900,191		392,001,921	498,891,351	835,136,356	60,164,777		*h* 119,197,263	1,726,880
	56,375	2,068,152,932	2,029,007,611	39,145,321		187,092,150	138,069,989	1,390,489,802	20,821,937	5,774,172	64,733,943	9,140,560
	45,135	1,522,748,500	1,315,115,400	207,633,100	10,950,800	155,660,800	(*d*)	*d* 1,041,912,000	55,676,900			73,055,800
	291,000	1,429,694,400	1,419,049,800	10,644,600								1,358,327,500
	0	1,403,252,940	1,386,364,970	16,887,970		223,442,705	110,024,685	711,302,659	28,976,480		174,482,790	4,290,945
	22,198	795,377,813	637,864,222	157,513,591	8,347,639	69,362,783	45,840,657	363,250,337	12,190,022		22,441,472	156,134,341
	14,155	505,251,769	266,177,323	239,074,446	11,973,699	80,084,753	41,882,014	184,612,768	22,633,266		1,067,496	95,836,265
	48,000	400,303,230	393,373,524	6,929,706	3,525,055	47,170,768	31,526,841	195,963,574	11,216,804		3,192,132	35,148,105
	48,645	384,512,454	237,386,080	147,126,374	4,144,595	60,810,390	78,897,513	103,757,307	31,523,822		29,083,799	1,795,860
	0	283,939,361	283,930,812	8,549		85,572,007	36,468,508	60,163,712	21,093,110	134,263	14,048,000	2,029,022
	0	276,436,132	275,075,344	1,360,788	136,302	34,678,357	36,462,637	141,977,162	5,247,116		13,663,210	9,256,922
	4,520	253,756,501	252,785,528	970,973	1,133,904	28,531,829	17,171,524	121,308,510	5,868,584		9,757,412	31,895,122
	350	242,095,275	318,921,795	*n* —76,826,520		50,932,814	21,940,961	78,507,104	22,580,707	420,460	12,303,610	5,074,740
	0	223,614,768	223,338,768	276,000	4,136,200	40,577,466	55,208,892	73,678,866	8,432,866		135,148	2,611,000
	23,740	216,374,355	85,581,974	130,792,381	6,475,225	36,341,538	31,612,727	54,072,458	5,543,470		867,000	42,179,481
	0	177,678,245	0	177,678,245	2,416,627	20,710,419	18,969,032	110,939,972	2,959,986		2,979,260	5,310,360
	0	131,135,733	214,212,880	—83,077,147	30,648	14,260,466	7,543,871	83,348,778	2,614,853		8,628,843	830,420
	0	115,642,930	112,189,430	3,453,500	112,578	24,802,606	9,090,660	35,924,988	11,690,872		14,304,283	3,147,300
	,846,445	28,466,498,378	25,157,432,175	3,309,066,203								
	0	4,191,045,000	2,110,284,000	*p* 2,080,761,000	2,000	604,209,000	468,276,000	1,570,505,000	111,116,000	25,000	853,648,000	*q* 31,598,000
	103,344	3,819,332,352	3,624,762,827	194,569,525	13,932,853	259,740,047	253,647,988	2,225,721,836	26,182,865		40,191,996	569,438,613
	9,550	2,534,561,100	2,526,298,900	8,262,200	12,598,000	*j* 362,339,000	462,607,100	1,177,309,900	52,352,200		68,706,300	92,891,600
	800	1,696,756,840	927,366,384	769,390,456	9,059,847	162,346,463	95,492,248	312,559,664	97,564,088		80,206,341	756,823,581
	0	1,457,969,255	1,457,887,679	81,576	5,009,403	204,184,957	160,132,183	699,017,791	18,708,537	31,765,059	133,425,760	14,583,800
	0	1,346,251,000	1,346,198,600	52,400								1,346,251,000
	0	1,252,490,212	1,257,012,770	*b* —4,522,558		192,308,570	131,803,432	501,502,772	66,845,119		105,983,295	94,237,249
	147,810	1,233,811,914	1,130,463,418	103,348,496	12,789,374	195,738,220	189,463,207	567,357,293	18,870,166		9,483,865	20,414,735
	19,705	1,210,496,055	1,097,535,213	112,960,842		221,475,256	145,809,586	473,789,633	29,262,368	3,141,992	112,891,969	33,881,266
	0	1,168,934,000	1,168,934,000									1,168,934,000
	1,950	876,899,592	844,906,175	31,993,417	5,851,454	112,124,805	123,629,995	274,339,999	13,371,614		28,612,625	216,377,149
	4,290	642,607,543	555,802,282	86,805,261	3,005,243	51,144,101	40,639,418	160,830,524	7,893,862	10,653,010	61,535,792	204,224,874
	5,000	492,963,903	308,178,003	184,785,900	1,486,905	48,785,194	48,192,099	252,076,657	10,448,986		41,248,598	25,944,142
	1,635	463,600,194	408,795,586	54,804,608	2,651,472	33,565,053	20,691,937	181,205,743	12,936,787		28,451,521	103,535,467
	0	453,088,903	380,248,083	72,840,820	4,200,694	44,068,243	38,366,386	240,739,096	6,760,156		1,532,956	63,261,298
	0	368,717,938	184,140,295	184,577,643	4,226,560	49,785,657	54,372,157	107,531,850	18,549,858			53,638,925
	0	360,488,633	305,655,046	54,833,587		61,346,384	81,887,851	153,082,245	17,511,767			1,675,631
	0	316,027,352	314,984,150	1,043,202		55,499,624	43,587,899	99,794,350	2,102,536	628,266	25,257,220	61,939,200
	0	291,344,894	286,515,944	4,828,950	1,436,412	34,251,165	52,860,999	163,758,752	4,798,094		1,777,510	3,363,141
	37,313	287,192,562	256,851,165	30,341,397	6,871,617	36,983,166	24,848,905	43,721,814	6,728,344	3,516,163	1,750,380	106,574,740
	45,232	258,398,400	246,347,796	12,050,604		35,201,416	26,260,834	107,325,852	7,298,503			32,843,077
	0	203,623,520	185,116,000	18,507,520	0	0	163,647	11,881,966	84,924,291	0	92,472,560	0
	384	177,112,090	1,529,348	175,582,742	2,058,298	16,843,389	13,961,589	80,369,487	2,129,186	2,385,179	650,010	17,160,980
	0	168,594,800	168,594,800	0		29,665,509	27,223,877	45,048,910	41,081,830			3,403,692
	0	147,493,112	45,354,800	102,138,312	1,191,122	9,686,456	13,930,865	70,924,972	2,416,020		8,461,042	14,134,620

50	The Ohio Public Service Company	8	130,100	0	0	453,088,903	380,248,083	72,840,820	4,200,694				

ers and Distribution of Energy
000,000 Kw.-Hr. During 1935

This tabulation is based on the operating company as the unit. Group statistics are given in a few instances for properties which, though distinct corporate entities, are operated in each case as a single physical system.

blic s ng al s)	Used by Company (18)	Not Accounted for (Losses) (19)	Number of Customers, Dec. 31, 1935: Farm or Rural if Not Included in Domestic (20)	Domestic (21)	Commercial Small Light and Power (Retail) (22)	Commercial Large Light and Power (Wholesale) (23)	Municipal Service (Street Lighting, etc.) (24)	Other Ultimate Consumers (25)	Electric Railway Operation (26)	Other Public Utilities Including Municipal (27)	Line No. (28)
760	47,767,858	290,252,926	450	415,531	60,040	11,487	171	.....	7	69	1
362	5,410,807	168,101,345	a 2,124	a 317,958	a 68,740	a 598	a 40	.....	a 2	a 10	2
789	16,721,323	63,712,553	.....	131,099	17,282	2,243	.....	73	3	15	3
000	5,301,000	71,603,000	.....	k 73,426	k 12,625	k 2,121	k 41	.....	k 2	k 9	4
528	47,471,578	68,281,080	.....	65,777	10,738	1,972	1,092	.....	1	11	5
024	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	6
868	3,681,867	34,156,705	.....	62,491	9,802	75	26	.....	1	4	7
000	4,078,499	40,449,932	.....	106,758	14,852	3,597	12	.....	.....	1	8
132	4,646,124	27,395,860	5,512	42,817	7,354	1,620	583	.....	1	24	9
987	1,033,720	18,649,148	265	41,640	5,181	408	206	.....	.....	3	10
698	2,343,994	17,809,950	497	35,744	4,812	888	262	.....	.....	1	11
600	2,984,842	25,154,511	4,037	36,378	8,271	17	387	.....	3	2	12
000	854,000	6,346,000	.....	a 19,667	a 3,031	a 843	a 15	.....	0	a 5	13
410	590,234	19,080,531	.....	26,159	(i)	l 2,310	64	.....	1	5	14
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
787	50,368,848	945,903,082	28,992	554,619	82,647	4,370	798	.....	14	67	15
....	37,000,000	815,500,000	.....	a 1,848,378	(d)	a d 424,351	a 2,128	.....	a 7	.....	16
120	29,314,073	364,254,567	.....	549,825	112,662	2,769	204	.....	9	19	17
880	22,968,282	339,337,725	.....	733,670	156,307	838	223	.....	4	2	18
560	.....	252,030,379	.....	275,146	47,502	3,065	469	1	14	12	19
800	.....	185,492,200	11,659	295,055	(d)	d 58,058	3,130	.....	.....	46	20
500	.....	71,366,900	.....	.....	.....	.....	.....	.....	.....	5	21
945	4,064,892	146,667,784	.....	287,746	28,958	1,931	173	.....	1	3	22
341	12,728,254	105,082,308	6,791	121,742	19,843	3,155	808	.....	3	12	23
265	3,274,687	63,886,821	13,055	119,279	18,575	3,175	1,431	.....	1	42	24
105	3,801,292	68,758,659	5,038	93,500	13,644	2,389	1,073	.....	2	13	25
860	18,124,176	56,374,992	5,642	105,621	12,194	847	948	.....	9	8	26
022	6,185,828	58,244,911	.....	126,765	17,478	5,468	148	.....	1	2	27
922	1,019,481	33,994,945	94	68,073	10,577	138	34	.....	2	4	28
122	3,365,176	34,724,440	1,722	49,351	8,068	210	567	.....	1	14	29
740	7,618,228	42,716,651	.....	76,903	11,444	842	998	5	1	4	30
000	2,696,372	36,137,958	4,145	66,852	14,886	60	122	.....	1	1	31
481	5,100,401	34,182,055	4,200	52,172	12,005	102	80	.....	.....	14	32
360	.....	13,392,589	2,497	34,218	5,461	156	33	.....	2	11	33
420	1,667,718	12,210,136	45	32,231	3,684	882	26	.....	1	2	34
300	1,457,157	15,112,486	103	38,732	5,367	899	348	.....	1	1	35
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
000	21,173,000	530,493,000	5	r 807,556	120,710	3,288	4	12	6	1	36
613	16,818,879	413,657,275	17,230	421,884	80,760	1,891	446	.....	21	73	37
600	24,069,700	281,687,300	18,928	j 489,894	76,127	436	491	.....	3	3	38
581	12,940,149	169,764,459	10,010	237,093	31,498	419	2,687	.....	6	10	39
800	6,194,344	184,947,421	5,789	271,005	32,043	579	147	329	3	4	40
000	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	41
249	18,319,129	141,490,646	.....	280,970	39,178	6,301	2,010	.....	11	12	42
735	12,297,960	207,397,094	18,460	272,600	51,737	693	282	.....	2	11	43
266	12,352,211	177,891,774	.....	275,825	46,038	654	350	130	3	17	44
000	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	45
149	4,784,081	97,807,870	6,571	152,677	21,779	269	60	.....	6	16	46
874	5,131,348	97,549,371	4,957	99,639	18,249	2,609	385	1,287	6	44	47
142	3,199,570	61,581,752	2,589	83,608	10,873	1,567	23	.....	5	11	48
467	10,370,898	70,191,316	3,557	61,234	10,563	2,042	992	.....	4	17	49
298	2,381,762	51,778,312	5,365	66,107	10,804	266	28	.....	0	12	50
925	16,828,247	63,784,684	3,825	111,067	27,338	159	1,828	.....	.....	13	51
631	6,496,533	38,488,222	.....	99,028	12,288	253	9	.....	.....	2	51a
200	1,824,243	25,394,014	.....	87,692	10,605	898	.....	.....	.....	.....	52
141	1,350,302	27,748,519	1,940	46,745	10,771	251	33	.....	1	4	53
740	5,418,854	50,778,579	9,412	69,002	13,019	3,285	185	63	0	41	54
077	5,681,948	43,786,770	.....	61,622	9,675	2,739	191	.....	.....	14	55
0	.....	14,181,056	0	0	12	7	.....	0	1	.....	56
980	2,177,649	39,376,323	3,230	39,035	7,849	1,146	109	638	1	17	57
692	.....	22,170,982	.....	44,148	7,326	158	153	.....	.....	1	58
620	13,364,219	13,383,796	2,283	17,013	2,936	1,020	219	.....	1	7	59
	44,068,243	38,366,386	240,739,096	6,760,156	.....	1,532,956	63,261,298	2,381,762	51,778,312	5,365	66,107	10,804

a Nos. 2, 16—Bills rendered in December. 13—Meters. 126—Active accounts.

b Nos. 7, 42—Net of purchase and exchange. 126—Includes 14,963 net interchange. 159—Incl. 1,205,592 net interchange.

c Commercial light, or light and power, combined with domestic service.

l Retail combined with wholesale.

e Canadian Niagara Power Co., Ltd. (see Canada), included in Niagara Hudson Power Corp. System.

f One station 600 kw. not used.

g Net of delivery and receipt under interchange contracts.

h Includes 88,697,863 transferred to two affiliated transportation cos.

i Entries under Domestic are light and cooking; under Commercial are power.

j Including water heater service (off peak).

k Average number.

l Exchanged for water power.

m Includes company's share of jointly owned plant (Stanton).

n Includes as credit 77,821,696 kw.-hr. economy flow to other companies.

o Includes company's share of jointly owned plant (Deepwater).

p Net; 2,124,244,000 kw.-hr. total purchased less 43,483,000 kw.-hr. sales for resale outside of Chicago.

q Sold to other public utilities in Chicago. (See also note p).

r Includes 36,186 hall light customers.

s Includes Ohio Power Company's share of jointly

384	177,112,090	1,529,348	175,582,742	2,058,298	16,843,389	13,961,589	80,369,487	2,129,186	2,385,179	650,010	17,160,980	
0	168,594,800	168,594,800	0	.....	29,665,509	27,223,877	45,048,910	41,081,830	.....	.....	3,403,692	
0	147,493,112	45,354,800	102,138,312	1,191,122	9,686,456	13,930,865	70,924,972	2,416,020	.....	8,461,042	14,134,620	
50	The Ohio Public Service Company	8		130,100	0		0	453,088,903	380,248,083	72,840,820	4,200,694	
51	Central Illinois Public Service Company	5		81,140	0		0	368,717,938	184,140,295	184,577,643	4,226,560	
51a	Indianapolis Power & Light Company	4		166,700	0		0	360,488,633	305,655,046	54,833,587	.....	
52	The Columbus Railway, Power and Light Co	6		132,500	0		0	316,027,352	314,984,150	1,043,202	.....	
53	Central Illinois Light Company	4		88,500	0		0	291,344,894	286,515,944	4,828,950	1,436,412	
54	Wisconsin Power and Light Company	6		49,604	31		37,313	287,192,562	256,851,165	30,341,397	6,871,617	
55	Wisconsin Public Service Corporation	5		42,900	18		45,232	258,398,400	246,347,796	12,050,604	.....	
56	City of Detroit, Public Lighting Commission	1		80,000	0		0	203,623,520	185,116,000	18,507,520	0	
57	Northern Indiana Power Company	10		23,000	2		384	177,112,090	1,529,348	175,582,742	2,058,298	
58	City of Cleveland, Department of Public Utilities	1		50,000	0		0	168,594,800	168,594,800	0	.....	
59	Indiana Service Corporation	1		31,000	0		0	147,493,112	45,354,800	102,138,312	1,191,122	
60	Western United Gas and Electric Company	2		41,325	1		125	114,213,818	93,280,600	20,933,218	.....	
61	City of Lansing, Board of Water & Elec. Lt. Comrs	3		65,500	1		1,000	107,685,118	107,685,118	0	.....	
62	Southern Indiana Gas and Electric Company	4		39,900	0		0	105,157,090	103,395,700	1,761,390	471,326	
63	Central Illinois Electric and Gas Company	4		43,738	1		1,200	103,563,210	19,998,919	83,564,291	653,903	
	Totals for section	151		6,664,376	145		379,338	25,850,420,400	21,464,123,601	4,386,296,799	.....	
	West North Central States											
64	Union Electric Light & Power Co. (Mo.) and Subs	7		457,170	2		264,000	2,009,565,810	2,009,531,650	34,160	.....	
65	Northern States Power Company	21	L	289,251	28	L	178,288	1,098,471,563	1,024,927,567	73,543,996	.....	
66	Kansas City Power & Light Company	3		247,250	0		0	652,654,977	650,140,448	2,514,529	2,894,423	
67	Minnesota Power & Light Company	5		30,420	11		94,911	407,968,000	407,074,000	894,000	657,000	
68	Nebraska Power Company	1		98,000	0		0	354,800,000	354,800,000	0	1,503,400	
69	Kansas Gas and Electric Company	2		70,000	0		0	265,793,700	265,727,000	66,700	2,216,000	
70	The Empire District Electric Co	1		66,500	4		19,720	240,380,110	236,977,740	3,402,370	940,261	
71	Des Moines Electric Light Company	2	L	73,800	1		500	206,358,724	206,358,724	0	1,284,579	
72	Iowa Public Service Co.-Sioux City Gas & Elec. Co	19		72,523	4		2,051	179,573,314	171,309,649	8,263,665	2,878,150	
73	Interstate Power Company (Delaware) and Subs	17	L	63,334	12	L	6,545	146,820,606	113,281,941	33,538,665	3,021,520	
74	Iowa Electric Light and Power Company	11		76,641	2		1,825	144,433,133	143,672,783	760,350	2,138,752	
75	Iowa-Nebraska L. & P. Co. and Maryville E. L. & P. Co	21	L	41,260	12	L	2,233	125,266,928	86,575,405	38,691,523	1,548,598	
76	Kansas City, Kans., Board of Public Utilities	1		39,000	0		0	123,564,750	123,564,750	0	0	
	Totals for section	111		1,625,149	76		570,073	5,955,651,615	5,793,941,657	161,709,958	.....	
	South Atlantic States											
77	Duke Power Company	6	L	255,750	42	L	503,813	1,792,111,249	1,447,368,144	344,743,105	(y)	
78	Georgia Power Company	21	L	93,204	25	L	290,187	1,445,556,056	1,070,271,672	375,284,384	6,130,795	
79	Consol. Gas & Elec. Lt. & Pwr. Co. of Baltimore	3		230,950	0		0	1,113,560,084	218,220,300	x 895,339,784	.....	
80	Carolina Power & Light Company	2		43,000	10		205,450	1,059,547,400	699,129,900	360,417,500	1,248,100	
81	Potomac Electric Power Company	2		220,000	0		0	725,463,909	572,361,709	153,102,200	3,944,885	
82	Virginia Electric and Power Company	6		127,502	8		29,320	531,014,980	415,741,320	115,273,660	4,818,050	
83	Assoc. Gas & Elec. System (South Carolina Group)	1		72,500	3		154,630	419,331,583	409,665,137	9,666,446	567,246	
84	Florida Power & Light Company	39		139,273	0		0	249,184,000	245,503,000	3,681,000	4,633,000	
85	Virginia Public Service Co. (Assoc. G. & E. System)	13	L	72,140	16	L	16,026	246,838,308	228,537,758	18,300,550	10,080,878	
86	Tampa Electric Company	2		35,000	0		0	154,575,830	144,836,180	z 9,739,650	1,109,081	
87	Delaware Power & Light Company	1		22,500	0		0	142,732,398	0	142,732,398	.....	
88	South Carolina Power Company	6		20,132	2		16,275	128,469,723	125,071,183	3,398,540	576,137	
89	Florida Power Corp. (Assoc. Gas & Elec. System)	7		44,109	3		14,180	122,754,775	112,306,130	10,448,645	864,471	
90	City of Jacksonville Municipal Elec. Light Plant	1		54,500	0		0	103,750,200	103,750,200	0	.....	
	Totals for section	110		1,430,560	109		1,229,881	8,234,890,495	5,792,762,633	2,442,127,862	.....	
	East South Central States											
91	Alabama Power Company	12	L	164,284	6		398,300	1,942,585,912	1,754,674,053	187,911,859	10,923,276	
92	The Tennessee Electric Power Company	15	L	109,292	13		132,931	782,935,160	607,833,652	175,101,508	3,772,777	
93	Louisville Gas & Electric Company	3		112,020	1		80,320	423,211,350	347,025,010	76,186,340	.....	
94	Tennessee Valley Authority	1		60,000	1		184,000	386,600,000	386,600,000	.....	.....	
95	Kentucky Utilities Company	11		49,360	2		24,300	323,462,105	270,472,984	52,989,121	2,654,479	
96	Birmingham Electric Company	1		11,700	0		0	230,824,000	.....	230,824,000	161,000	
97	Memphis Power & Light Company	1		54,000	0		0	197,482,000	197,478,000	4,000	261,000	
98	Mississippi Power & Light Company	33		19,040	0		0	165,465,000	8,621,000	155,844,000	1,777,000	
99	Mississippi Power Company	18	L	18,822	0		0	118,302,350	20,174,627	98,127,723	451,737	
100	Tennessee Public Service Company	1		6,125	1		150	113,953,970	456,830	113,497,140	651,000	
	Totals for section	96		604,643	24		820,001	4,683,821,847	3,593,336,156	1,090,485,691	.....	
	West South Central States											
101	Louisiana Power & Light Company	15		87,376	0		0	572,219,000	472,911,000	99,308,000	1,801,000	
102	Houston Lighting & Power Company	5		184,586	0		0	517,942,000	492,419,000	25,523,000	2,958,000	
103	Oklahoma Gas & Electric Company	16		182,600	0		0	507,655,960	476,855,715	30,800,245	750,206	
104	Texas Power & Light Company	16		99,211	4		885	448,880,000	432,306,000	16,574,000	2,424,000	
105	Texas Electric Service Company	12		101,407	0		0	357,959,000	352,335,000	5,624,000	631,000	
106	Arkansas Power & Light Company	19	L	33,812	3	L	65,666	346,829,000	192,127,000	154,702,000	1,186,000	
107	New Orleans Public Service Inc	1		108,000	0		0	339,545,000	339,537,000	8,000	.....	
108	Gulf States Utilities Company	11		75,691	0		0	258,441,774	167,671,574	90,770,200	5,597,867	
109	Dallas Power & Light Company	1		82,500	0		0	240,613,000	234,607,900	6,006,000	.....	
110	Louisiana Steam Generating Corporation	1		45,000	0		0	234,397,900	234,397,900	.....	0	
111	West Texas Utilities Company	17		53,162	0		0	229,654,309	225,326,616	4,327,693	1,017,805	
112	Southwestern Gas and Electric Company	12		42,976	0		0	220,277,035	180,780,319	39,496,716	692,634	
113	Public Service Company of Oklahoma	14		79,080	0		0	218,847,118	187,969,652	30,877,466	1,040,421	
114	Central Power and Light Company	28		60,422	5		15,000	209,740,473	175,630,213	34,110,260	6,093,331	
115	San Antonio Public Service Company	3		99,700	3		700	178,991,700	130,114,700	48,877,000	1,333,157	
116	El Paso Electric Company	4		56,529	0		0	103,776,867	103,613,067	163,800	806,675	
	Totals for section	175		1,392,052	15		82,251	4,985,771,036	4,398,602,656	587,168,380	.....	
	Mountain States											
117	Montana Power Company	2		900	14		294,500	1,292,318,000	1,263,165,000	29,153,000	2,533,000	
118	Utah Power & Light Company	6	L	26,740	28	L	168,542	564,307,000	362,267,000	202,040,000	7,746,000	
119	Idaho Power Company	1		300	10		81,575	434,959,000	406,104,000	28,855,000	19,130,000	
120	Public Service Company of Colorado	12	L	88,857	10	L	37,055	354,295,874	349,709,974	4,585,900	2,529,916	
121	Salt River Valley Water Users' Association	0		0	8		70,050	260,516,149	231,516,995	28,999,154	6,741,845	
	Totals for section	21		116,797	70		651,722	2,906,396,023	2,612,762,969	293,633,054	.....	
	Pacific States											
122	Pacific Gas and Electric Company	10		369,800	49		876,794	4,463,309,951	3,425,983,055	1,037,326,896	519,751,757	
		3	L	415,000	23	L	488,640	3,139,306,603	3,118,016,988	21,289,615	346,629,643	
0	453,088,903	380,248,083	72,840,820	4,200,694	44,068,243	38,366,386	240,739,096	6,760,156	.....	1,532,956	63,261,298	

| | | |

	Pacific States											
122	Pacific Gas and Electric Company	10	369,800	49	876,794	4,463,309,951	3,425,983,055	1,037,326,896	519,751,757			
		3	415,000	23	488,640	3,139,306,603	3,118,016,988	21,289,615	346,629,643			
0	453,088,903	380,248,083	72,840,820	4,200,694	44,068,243	38,366,386	240,739,096	6,760,156		1,532,956	63,261,298	
0	368,717,938	184,140,295	184,577,643	4,226,560	49,785,657	54,372,157	107,531,850	18,549,858			53,638,925	
0	360,488,633	305,655,046	54,833,587		61,346,384	81,887,851	153,082,245	17,511,767			1,675,631	
0	316,027,352	314,984,150	1,043,202		55,499,624	43,587,899	99,794,350	2,102,536	628,266	25,257,220	61,939,200	
0	291,344,894	286,515,944	4,828,950	1,436,412	34,251,165	52,860,999	163,758,752	4,798,094		1,777,510	3,363,141	
37,313	287,192,562	256,851,165	30,341,397	6,871,617	36,983,166	24,848,905	43,721,814	6,728,344	3,516,163	1,750,380	106,574,740	
45,232	258,398,400	246,347,796	12,050,604		35,201,416	26,260,834	107,325,852	7,298,503			32,843,077	
0	203,623,520	185,116,000	18,507,520	0	0	163,647	11,881,966	84,924,291	0	92,472,560	0	
384	177,112,090	1,529,348	175,582,742	2,058,298	16,843,389	13,961,589	80,369,487	2,129,186	2,385,179	650,010	17,160,980	
0	168,594,800	168,594,800	0		29,665,509	27,223,877	45,048,910	41,081,830			3,403,692	
0	147,493,112	45,354,800	102,138,312	1,191,122	9,686,456	13,930,865	70,924,972	2,416,020		8,461,042	14,134,620	
125	114,213,818	93,280,600	20,933,218		21,883,041	27,147,447	14,737,368	1,358,447		1,021,269	22,547,191	
1,000	107,685,118	107,685,118	0		20,565,638	21,195,718	54,818,132	3,839,495	256,932			
0	105,157,090	103,395,700	1,761,390	471,326	15,656,875	23,602,776	40,636,342	2,495,469		7,829,867	415,440	
1,200	103,563,210	19,998,919	83,564,291	653,903	18,879,730	15,771,932	39,932,054	6,113,738		4,293,174	225,221	
379,338	25,850,420,400	21,464,123,601	4,386,296,799									
264,000	2,009,565,810	2,009,531,650	34,160		236,413,007	245,260,686	728,321,785	30,949,671		143,415,646	325,483,131	
178,288	1,098,471,563	1,024,927,567	73,543,996		209,673,061	161,457,988	376,647,401	68,103,949		517,480	52,679,158	
0	652,654,977	650,140,448	2,514,529	2,894,423	91,416,853	134,798,174	189,000,355	12,782,401		93,899,347	51,574,012	
94,911	407,968,000	407,074,000	894,000	657,000	24,872,000	(d)	d 241,858,000	29,831,000			46,032,000	
0	354,800,000	354,800,000	0	1,503,400	45,319,500	(d)	d 166,091,900	29,759,000			83,008,000	
0	265,793,700	265,727,000	66,700	2,216,000	35,995,000	(d)	d 163,119,000	9,629,000			15,108,000	
19,720	240,380,110	236,977,740	3,402,370	940,261	8,515,685	10,358,162	104,827,791	1,799,796		3,839,900	64,344,673	
500	206,358,724	206,358,724	0	1,284,579	30,240,438	17,416,099	72,040,300	5,220,418	3,820,588		40,339,470	
2,051	179,573,314	171,309,649	8,263,665	2,878,150	31,090,060	28,925,398	55,944,204	12,937,504	32,815	4,304,105	9,925,678	
6,545	146,820,606	113,281,941	33,538,665	3,021,520	29,587,548	32,853,144	22,520,679	10,657,305			17,175,268	
1,825	144,433,133	143,672,783	760,350	2,138,752	21,584,208	12,947,883	64,193,940	2,218,565		6,426,944	15,654,651	
2,233	125,266,928	86,575,405	38,691,523	1,548,598	29,050,710	26,955,803	33,377,984	2,847,017		850,703	7,253,163	
0	123,564,750	123,564,750	0	0	20,689,116	10,104,978	63,644,707	16,510,656				
570,073	5,955,651,615	5,793,941,657	161,709,958									
503,813	1,792,111,249	1,447,368,144	344,743,105	(y)	(y)	(y)	y 1,489,213,544	(y)	(y)	(y)	(y)	
290,187	1,445,556,056	1,070,271,672	375,284,384	6,130,795	126,984,380	165,161,950	684,583,439	16,010,413	w 9,339,039	50,465,743	78,382,069	
0	1,113,560,084	218,220,300	x 895,339,784		178,293,208	101,305,096	492,833,742	20,087,728		203,775,231	9,780,764	
205,450	1,059,547,400	699,129,900	360,417,500	1,248,100	46,683,400	(d)	d 342,544,100	37,524,900			454,468,100	
0	725,463,909	572,361,709	153,102,200	3,944,885	141,732,248	170,825,155	168,506,261	20,911,100		101,294,372	766,400	
29,320	531,014,980	415,741,320	115,273,660	4,818,050	90,101,127	102,536,489	198,566,251	11,261,543	0	2,227,691	17,267,305	
154,630	419,331,583	409,665,137	9,666,446	567,246	8,750,245	8,633,058	91,529,168	2,953,733		1,000,428	270,125,310	
0	249,184,000	245,503,000	3,681,000	4,633,000	66,450,000	(d)	d 86,722,000	19,014,000			15,418,000	
16,026	246,838,308	228,537,758	18,300,550	10,080,878	43,678,238	23,223,198	100,837,206	4,213,101		5,244,300	9,611,619	
0	154,575,830	144,836,180	z 9,739,650	1,109,081	15,625,448	24,067,522	79,692,897	2,769,467		8,021,440	z 499,884	
0	142,732,398	0	142,732,398		21,214,623	(d)	d 87,988,146	2,470,233		11,411,593	7,920,207	
16,275	128,469,723	125,071,183	3,398,540	576,137	14,558,568	13,981,141	49,405,426	1,992,317	w 9,669,410	1,074,590	17,817,617	
14,180	122,754,775	112,306,130	10,448,645	864,471	15,599,450	12,371,116	19,331,734	1,999,826			50,628,770	
0	103,750,200	103,750,200	0		i 37,666,871	i 44,112,726		4,657,759		1,030,040	1,269,600	
1,229,881	8,234,890,495	5,792,762,633	2,442,127,862									
398,300	1,942,585,912	1,754,674,053	187,911,859	10,923,276	72,721,241	75,192,154	764,492,181	6,295,323	w —14,318,759	4,535,418	749,239,514	
132,931	782,935,160	607,833,652	175,101,508	3,772,777	90,546,649	81,437,222	367,988,257	4,721,814	w —18,069,287	27,403,775	32,848,300	
80,320	423,211,350	347,025,010	76,186,340		52,476,515	43,712,491	129,052,255	27,995,812	154,640	37,685,803	84,688,520	
184,000	386,600,000	386,600,000									386,600,000	
24,300	323,462,105	270,472,984	52,989,121	2,654,479	21,618,211	18,651,586	102,694,716	7,423,867	11,069		121,968,052	
0	230,824,000		230,824,000	161,000	30,599,000	(d)	d 125,511,000	6,470,000			36,712,000	
0	197,482,000	197,478,000	4,000	261,000	27,773,000	(d)	d 92,215,000	8,029,000			41,544,000	
0	165,465,000	8,621,000	155,844,000	1,777,000	18,062,000	(d)	d 92,983,000	16,170,000			2,319,000	
0	118,302,350	20,174,627	98,127,723	451,737	16,610,664	26,623,264	48,883,828	2,191,042	w — 2,034,720	38,800	1,702,660	
150	113,953,970	456,830	113,497,140	651,000	16,887,000	(d)	d 69,494,000	4,787,000			7,638,000	
820,001	4,683,821,847	3,593,336,156	1,090,485,691									
0	572,219,000	472,911,000	99,308,000	1,801,000	10,817,000	(d)	d 204,722,000	4,937,000			311,594,000	
0	517,942,000	492,419,000	25,523,000	2,958,000	58,972,000	(d)	d 320,680,000	33,208,000			38,615,000	
0	507,655,960	476,855,715	30,800,245	750,206	65,004,893	63,473,252	233,954,438	25,494,523		13,601,293	21,678,219	
885	448,880,000	432,306,000	16,574,000	2,424,000	48,224,000	(d)	d 213,463,000	26,018,000			63,497,000	
0	357,959,000	352,335,000	5,624,000	631,000	38,383,000	(d)	d 204,977,000	19,595,000			21,046,000	
65,666	346,829,000	192,127,000	154,702,000	1,186,000	26,866,000	(d)	d 170,392,000	11,473,000			69,322,000	
0	339,545,000	339,537,000	8,000		35,792,000	(d)	d 134,436,000	22,865,000			109,666,000	
0	258,441,774	167,671,574	90,770,200	5,597,867	27,414,663	25,876,070	128,862,960	874,712	4,057,962	1,796,281	17,289,104	
0	240,613,000	234,607,900	6,006,000		43,691,384	(d)	d 109,335,952	24,578,379			28,455,772	
0	234,397,900	234,397,900		0	0	0	0	0	109,625,650	0	124,743,800	
0	229,654,309	225,326,616	4,327,693	1,017,805	24,865,634	22,354,264	44,264,624	6,229,399		24,381	81,318,106	
0	220,277,035	180,780,319	39,496,716	692,634	28,167,346	35,030,466	94,510,517	7,655,234		5,979,296	9,980,504	
0	218,847,118	187,969,652	30,877,466	1,040,421	33,591,643	17,786,988	107,023,264	7,595,051		1,548,890	16,897,030	
15,000	209,740,473	175,630,213	34,110,260	6,093,331	27,743,971	34,022,762	49,585,155	8,063,431			8,035,898	
700	178,991,700	130,114,700	48,877,000	1,333,157	28,356,719	66,333,748	38,514,478	1,893,258			11,369,153	
0	103,776,867	103,613,067	163,800	806,675	13,855,924	19,974,453	40,875,158	1,004,583	109,372	5,859,980	6,586,944	
82,251	4,985,771,036	4,398,602,656	587,168,380									
294,500	1,292,318,000	1,263,165,000	29,153,000	2,533,000	41,042,000	(d)	d 821,977,000	152,518,000			81,035,000	
168,542	564,307,000	362,267,000	202,040,000	7,746,000	58,585,000	(d)	d 343,749,000	17,273,000			37,708,000	
81,575	434,959,000	406,104,000	28,855,000	19,130,000	34,080,000	(d)	d 78,580,000	10,042,000			220,091,000	
37,055	354,295,874	349,709,974	4,585,900	2,529,916	52,063,407	47,634,484	150,449,661	9,052,500	25,561,608	31,838	3,412,323	
70,050	260,516,149	231,516,995	28,999,154	6,741,845	0	0	0	0	90,796,423	0	85,995,581	
651,722	2,906,396,023	2,612,762,969	293,633,054									
876,794	4,463,309,951	3,425,983,055	1,037,326,896	519,751,757	487,945,843	349,204,673	1,468,865,062	56,523,682	0	240,940,932	177,754,948	
488,640	3,139,306,603	3,118,016,988	21,289,615	346,629,643	276,099,434	189,816,372	778,298,561	33,667,987	w 13,690,987	242,655,361	645,990,734	
101	Louisiana Power & Light Company											

7	487,945,843	349,204,673	1,468,865,062	56,523,682		0	240,940,932		177,754,948	70,104,633	1,092,218,421		35,236	618,050	90,507			

651,722	2,906,396,023	2,612,762,969	293,633,054										
876,794	4,463,309,951	3,425,983,055	1,037,326,896	519,751,757	487,945,843	349,204,673	1,468,865,062	56,523,682		0	240,940,932	177,754,948	
488,640	3,139,306,603	3,118,016,988	21,289,615	346,629,643	276,099,434	189,816,372	778,298,561	33,667,987	w	13,690,987	242,655,361	645,990,734	

101	Louisiana Power & Light Company	15		87,376	0		0	572,219,000		472,911,000		99,308,000		1,801,000	
102	Houston Lighting & Power Company	5		184,586	0		0	517,942,000		492,419,000		25,523,000		2,958,000	
103	Oklahoma Gas & Electric Company	16		182,600	0		0	507,655,960		476,855,715		30,800,245		750,206	
104	Texas Power & Light Company	16		99,211	4		885	448,880,000		432,306,000		16,574,000		2,424,000	
105	Texas Electric Service Company	12		101,407	0		0	357,959,000		352,335,000		5,624,000		631,000	
106	Arkansas Power & Light Company	19	L	33,812	3	L	65,666	346,829,000		192,127,000		154,702,000		1,186,000	
107	New Orleans Public Service Inc	1		108,000	0		0	339,545,000		339,537,000		8,000			
108	Gulf States Utilities Company	11		75,691	0		0	258,441,774		167,671,574		90,770,200		5,597,867	
109	Dallas Power & Light Company	1		82,500	0		0	240,613,000		234,607,900		6,006,000			
110	Louisiana Steam Generating Corporation	1		45,000	0		0	234,397,900		234,397,900				0	
111	West Texas Utilities Company	17		53,162	0		0	229,654,309		225,326,616		4,327,693		1,017,805	
112	Southwestern Gas and Electric Company	12		42,976	0		0	220,277,035		180,780,319		39,496,716		692,634	
113	Public Service Company of Oklahoma	14		79,080	0		0	218,847,118		187,969,652		30,877,466		1,040,421	
114	Central Power and Light Company	28		60,422	5		15,000	209,740,473		175,630,213		34,110,260		6,093,331	
115	San Antonio Public Service Company	3		99,700	3		700	178,991,700		130,114,700		48,877,000		1,333,157	
116	El Paso Electric Company	4		56,529	0		0	103,776,867		103,613,067		163,800		806,675	
	Totals for section	175		1,392,052	15		82,251	4,985,771,036		4,398,602,656		587,168,380			
	Mountain States														
117	Montana Power Company	2		900	14		294,500	1,292,318,000		1,263,165,000		29,153,000		2,533,000	
118	Utah Power & Light Company	6	L	26,740	28	L	168,542	564,307,000		362,267,000		202,040,000		7,746,000	
119	Idaho Power Company	1		300	10		81,575	434,959,000		406,104,000		28,855,000		19,130,000	
120	Public Service Company of Colorado	12	L	88,857	10	L	37,055	354,295,874		349,709,974		4,585,900		2,529,916	
121	Salt River Valley Water Users' Association	0		0	8		70,050	260,516,149		231,516,995		28,999,154		6,741,845	
	Totals for section	21		116,797	70		651,722	2,906,396,023		2,612,762,969		293,633,054			
	Pacific States														
122	Pacific Gas and Electric Company	10		369,800	49		876,794	4,463,309,951		3,425,983,055		1,037,326,896		519,751,757	
123	Southern California Edison Company, Ltd	3	L	415,000	23	L	488,640	3,139,306,603		3,118,016,988		21,289,615		346,629,643	
124	Puget Sound Power & Light Company	3	L	104,500	12		209,775	914,812,000		908,171,000		6,641,000		37,318,000	
125	Washington Water Power Company (The)	1		150	9		144,910	854,380,000		473,650,000		380,730,000		19,050,000	
126	City of Los Angeles, Bureau of Power & Light	0		0	5		110,605	798,261,643		266,155,100	b	532,106,543		0	
127	Portland General Electric Company	3		75,500	5		93,730	583,071,000		552,011,000		31,060,000			
128	California Oregon Power Company	2	L	15,350	12		100,080	515,252,331		505,809,131		9,443,200			
129	Hetch Hetchy Water Supply (San Francisco)	0		0	2		83,300	507,977,590		507,977,590		0			
130	Los Angeles Gas & Electric Corporation	2		148,700	0		0	437,156,341		428,859,727		8,296,614			
131	Chelan Electric Company	0		0	3		58,624	365,072,000		365,072,000		0			
132	Nevada-California Electric Corp. System (N)	3		8,157	13	L	60,825	355,878,311	O	266,914,099		88,964,212		41,074,889	
133	Northwestern Electric Company	2		42,500	1		9,600	351,536,000		124,588,000		226,948,000		2,665,000	
134	City of Seattle—Dept. of Lighting	1		30,000	3		97,500	349,967,300		338,529,300		11,438,000			
135	City of Tacoma, Dept. of Public Utilities	2		34,000	3		114,000	276,098,322		275,939,322		159,000			
136	Pacific Power & Light Company	1		8,000	8	L	21,467	243,266,000		144,401,000		98,865,000		18,188,000	
137	San Diego Consolidated Gas & Electric Company	2		74,000	0		0	205,337,598		202,625,775		2,711,823			
138	Island Power & Light Company	0		0	3		46,900	191,918,000		191,918,000		0			
139	Turlock-Modesto Irrigation Districts	1		1,000	2		34,000	153,917,750		153,522,950		394,800		(P)	
	Totals for section	36		1,326,657	153		2,550,750	14,706,518,740		12,250,144,037		2,456,374,703			
	Canada														
140	Hydro-Electric Power Commission of Ontario	1		20,000	40		1,014,200	6,954,453,468		4,803,361,582		2,151,091,886			
141	Shawinigan Water & Power Company	0		0	9		619,150	4,777,711,082		3,696,755,786		1,080,955,296		2,206,944	
142	Canadian Hydro-Electric Corporation, Ltd	1		6,750	18		486,245	2,843,388,706		2,841,002,183		2,386,523			
143	Saguenay Power Company, Ltd	0		0	1		330,000	2,220,640,856		2,206,304,856		14,336,000			
144	Montreal Light, Heat & Power Consolidated	1		16,500	4		215,410	2,071,625,524		829,672,900		1,241,952,624			
145	West Kootenay Power and Light Company, Ltd	0		0	5		169,825	916,891,229		916,891,229		0		1,147,006	
146	Alcoa Power Company, Ltd	0		0	1		200,000	832,239,594		832,239,594		0			
147	Beauharnois Light, Heat & Power Company	0		0	1		311,000	825,901,000		825,901,000		0			
148	Winnipeg Electric Company (W)	1		12,000	3		251,058	657,958,100		657,958,100		0			
149	Canada Northern Power Corporation, Ltd	0		0	9		94,375	577,265,540		476,640,540		100,625,000			
150	City of Winnipeg Hydro-Electric System	1	T	11,190	2		96,234	552,752,450		444,220,950		108,443,500			
151	Canadian Niagara Power Company, Ltd	0		0	1		75,000	525,570,000		525,570,000					
152	British Columbia Electric Railway (Y)	1	X	17,500	5	X	167,325	417,787,590		417,787,590		0			
153	Abitibi Electric Development Company, Ltd	0		0	1	X	45,000	281,557,016		281,557,016		0			
154	Great Lakes Power Company, Ltd	0		0	2		39,200	241,458,062		241,458,062		0		36,489	
155	Ottawa Valley Power Company	0		0	1		80,000	239,609,370		239,609,370					
156	The Nova Scotia Power Commission	0		0	13	Z	62,955	216,227,296	O	216,227,296					c
157	Southern Canada Power Company, Ltd	0		0	5		43,865	203,264,130		174,673,730		28,590,400		675,000	
158	Montreal Island Power Company	0		0	1		45,000	193,833,300		193,833,300					
159	Calgary Power Company, Ltd	4	L	14,090	3		53,000	144,956,182		143,595,320	b	1,360,862		228,076	
	Totals for Canada	10		98,030	125		4,398,842	25,695,090,495		20,965,260,404		4,729,742,091			
	Mexico														
160	The Mexican Light & Power Co., Ltd. & Subsidiaries	2		32,240	14		179,500	921,842,791		921,724,591		118,200			
	Electric Railways and Electrified Railroads														
161	Interborough Rapid Transit Company	2		390,000	0		0	1,158,592,929		1,158,468,700		124,229			
162	Chicago Surface Lines	0		0	0		0	622,972,653		0		622,972,653			
163	Williamsburgh Power Plant Corporation (B.M.T.)	2		204,100	0		0	597,495,776		597,495,776		0			
164	Pennsylvania Railroad Company	1		88,000	0		0	356,189,680		307,968,530		48,221,150			
165	Philadelphia Rapid Transit Company	0		0	0		0	302,650,740		0		302,650,740			
166	Boston Elevated Railway Company	2		180,000	0		0	224,417,750		224,417,750		0			
167	New York Central R.R. Co.—Electric Division	2		110,000	0		0	220,871,582		161,137,582		59,734,000			
168	New York, New Haven & Hartford Railroad Co	1		47,200	0		0	164,550,700		83,069,800		81,480,900			
169	St. Louis Public Service Company	1		12,000	0		12,000	141,028,510		4,852,610		136,175,900			
170	Pacific Electric Railway Company	0		0	0		0	133,734,406		0		133,734,406			
171	Twin City Rapid Transit Company	1		75,000	2	L	16,000	124,673,675		91,216,550	B	33,457,125			
172	Norfolk & Western Railway Company	6		43,855	0		0	117,657,031		83,250,941		34,406,090			
173	Chicago, Milwaukee, St. Paul & Pacific R.R. Co.	0		0	0		0	92,018,250		0		92,018,250			
	Totals for Railways and Railroads	18		1,150,155	2		28,000	4,256,853,682		2,711,878,239		1,544,975,443			

												Leased plants *additional* to reported generator rating			
3,948	70,104,633	1,092,218,421	35,236	618,050	90,507	37,634	680	0	15	33	122				
0,734	4,855,997	607,601,527	14,552	399,997	51,992	21,977	364		3	11	123				
00	10,817,000	(a)	a 204,722,000	4,937,000				311,594,000			36,348,000	1,790	22,067	(d)	d
00	58,972,000	(d)	d 320,680,000	33,208,000				38,615,000			63,509,000	398	91,111	(d)	d
96	65,004,893	63,473,252	233,954,438	25,494,523		13,601,293		21,678,219	3,060,446		80,638,690	526	105,255	23,410	
00	48,224,000	(d)	d 213,463,000	26,018,000				63,497,000			95,254,000	1,900	84,063	(d)	d
00	38,383,000	(d)	d 204,977,000	19,595,000				21,046,000			73,327,000	456	62,249	(d)	d
00	26,866,000	(d)	d 170,392,000	11,473,000				69,322,000			67,590,000	1,751	46,363	(d)	d
	35,792,000	(d)	d 134,436,000	22,865,000				109,666,000			36,786,000		77,468	(d)	d
57	27,414,663	25,876,070	128,862,960	874,712	4,057,962	1,796,281		17,289,104	7,331,142		39,341,013	199	37,325	8,343	
	43,691,384	(d)	d 109,335,952	24,578,379				28,455,772			34,552,513		61,551	(d)	d
0	0	0	0	0	109,625,650	0		124,743,800	0		28,450	0	0	0	
05	24,865,634	22,354,264	44,264,624	6,229,399		24,381		81,318,106	8,068,763		41,511,333	910	C 31,622	C 11,187	
84	28,167,346	35,030,466	94,510,517	7,655,234		5,979,296		9,980,504	5,958,842		32,302,196	1,031	47,078	11,611	
21	33,591,643	17,786,988	107,023,264	7,595,051		1,548,890		16,897,030	1,820,080		31,543,751	847	50,230	10,036	
31	27,743,971	34,022,762	49,585,155	8,063,431				8,035,898	22,355,076		53,840,849	1,412	39,943	14,812	
57	28,356,719	66,333,748	38,514,478	1,893,258				11,369,153	1,066,609		30,124,578	987	54,363	10,508	
75	13,855,924	19,974,453	40,875,158	1,004,583	109,372	5,859,980		6,586,944	1,021,738		13,682,040	455	17,651	3,365	
00	41,042,000	(d)	d 821,977,000	152,518,000				81,035,000	21,845,000		171,368,000	2,039	59,592	(d)	d
00	58,585,000	(d)	d 343,749,000	17,273,000				37,708,000			99,246,000	11,906	75,134	(d)	d
00	34,080,000	(d)	d 78,580,000	10,042,000				220,091,000			73,036,000	10,407	29,275	(d)	d
16	52,063,407	47,634,484	150,449,661	9,052,500	25,561,608	31,838		3,412,323	4,007,450		59,552,687	2,739	98,654	15,339	
45	0	0	0	0	90,796,423	0		85,995,581	37,673,133		39,309,167	4,789	0	0	
57	487,945,843	349,204,673	1,468,865,062	56,523,682	0	240,940,932		177,754,948	70,104,633		1,092,218,421	35,236	618,050	90,507	
43	276,099,434	189,816,372	778,298,561	33,667,987	w 13,690,987	242,655,361		645,990,734	4,855,997		607,601,527	14,552	399,997	51,992	
00	126,916,000	174,623,000	228,084,000	29,976,000		53,350,000		25,968,000	5,082,000		233,495,000	25,031	121,492	21,589	
00	87,032,000	(d)	d 338,070,000	29,544,000				229,609,000			151,075,000	5,296	53,155	(d)	d
0	122,913,803	314,623,276	195,793,469	54,916,361	0	0		0	7,023,990		102,990,744	0	a 196,871	a 43,903	a
	98,434,912	68,628,260	214,208,652	24,628,781		53,446,435		15,731,683	3,676,819		104,315,458		95,556	11,940	
	36,487,318	12,995,884	58,391,387	2,197,640				319,106,117	3,467,374		82,606,611		21,805	4,378	
								473,890,200	2,506,405		31,580,985				
	M 200,569,349	(M)	M 119,939,050	4,837,048				53,554,322	5,537,781		52,718,791		M 153,481	(M)	M
								365,072,000							
89	20,292,063	32,371,648	137,336,551	671,853				21,243,043	8,952,470		93,935,794	1,373	24,220	7,691	
00	37,820,000	(d)	d 228,121,000	4,632,000				30,701,000			47,597,000	4,108	32,577	(d)	d
	86,101,559	62,567,772	65,105,155	18,808,585		31,301,069		3,000	13,422,650		72,657,510		80,087	11,496	
	45,633,247	44,609,618	113,117,060	8,903,598		852,800		17,081,555	1,115,740		44,784,704		29,236	4,906	
00	46,172,000	(d)	d 70,935,000	10,999,000				41,141,000			55,831,000	8,951	36,698	(d)	d
	40,829,369	41,255,744	55,043,846	11,978,162		15,442,000		6,401,120	3,135,551		31,251,806		64,617	11,958	
								191,856,000			62,000				
	(P)	(P)	P 61,398,417	(P)	(P)	0		78,516,230	563,550		13,439,553	(P)	(P)	(P)	P
44	28,789,484	20,402,636	1,926,640,442	4,084,370	Q 1,826,031,529			603,185,085	5,860,129		360,510,463	7,663	39,790	12,623	
	19,400,000	10,170,346	1,594,621,190	1,202,300		3,230,340		1,148,264,530			66,500,000		18,129	3,196	
			1,556,732,893					628,012,924			35,895,039				
	115,392,045	189,004,562	847,955,490	17,653,162	S 582,415,540	119,956,023		22,870,310			176,378,392		208,132	40,648	
06	3,350,075	1,884,684	811,136,020	415,293				5,201,355	1,036,057		92,720,739	28	4,040	790	
	293,594		725,757,300					15,453,000			90,735,700		13		
			75,824,000					742,730,000			7,347,000				
	94,393,889	39,258,267	120,006,166	1,713,176	137,306,165	37,278,546		127,431,294	12,446,485		88,124,112				
	14,147,869	7,397,011	506,046,695	859,204							48,814,761		12,851	2,848	
	186,685,374	74,323,766	47,413,424	14,954,272	U 167,386,400			592,560			61,396,654		40,444	6,047	
	77,198,126	55,833,282	146,072,916	10,919,162		81,051,864		6,399,793	7,885,591		32,426,856		83,520	14,394	
			279,833,016	1,724,000											
89	131,748	67,961	216,598,307	42,444		1,193,512		15,745,800	425,184		7,216,617	90	241	91	
								237,844,220	1,765,150						
	c 458,698	(c)	156,544,738	46,547				47,631,432	960,312		10,585,569		c 1,237	(c)	
00	13,630,000	7,730,000	91,275,760	3,650,000	16,555,200			58,669,800	1,235,140		9,843,230	1,320	18,153	4,301	
								193,833,300							
76	3,049,002	5,775,870	10,356,248	1,167,813				101,846,637	470,202		22,062,334	292	7,565	4,920	
	50,262,416	26,376,322		55,750,752	R 378,457,401	72,081,924			7,876,660		331,037,316		132,198	44,200	

Summary of Generator Rating and Output

Section	Number of Companies or Systems	Number of Generating Plants and Generator Ratings — All Plants — No.	All Plants — Rating Kw.	Fuel Plants — No.	Fuel Plants — Rating Kw.	Hydro Plants — No.	Hydro Plants — Rating Kw.	Energy Generated (Net), Kw.-Hr.	Energy, Purchased, Kw.-Hr.	Total Output Gen. and Purc Kw.-Hr.
United States	**140**	**1,784**	**30,494,993**	**879**	**21,653,592**	**905**	**8,841,401**	**86,694,511,475**	**16,200,413,715**	**102,894,925,19**
New England	14	167	2,242,117	42	1,531,177	125	710,940	5,631,405,591	1,473,551,065	7,104,956,65
Middle Atlantic	21	325	8,808,626	137	6,962,181	188	1,846,445	25,157,432,175	3,309,066,203	28,466,498,37
East North Central	29	296	7,043,714	151	6,664,376	145	379,338	21,464,123,601	4,386,296,799	25,850,420,40
West North Central	13	187	2,195,222	111	1,625,149	76	570,073	5,793,941,657	161,709,958	5,955,651,61
South Atlantic	14	219	2,660,441	110	1,430,560	109	1,229,881	5,792,762,633	2,442,127,862	8,234,890,49
East South Central	10	120	1,424,644	96	604,643	24	820,001	3,593,336,156	1,090,485,691	4,683,821,84
West South Central	16	190	1,474,303	175	1,392,052	15	82,251	4,398,602,656	587,168,380	4,985,771,03
Mountain	5	91	768,519	21	116,797	70	651,722	2,612,762,969	293,633,054	2,906,396,02
Pacific	18	189	3,877,407	36	1,326,657	153	2,550,750	12,250,144,037	2,456,374,703	14,706,518,74
Canada	**20**	**135**	**4,496,87**	**10**	**98,030**	**125**	**4,398,842**	**20,965,260,404**	**4,729,742,091**	**25,695,090,49**
Mexico	**1**	**16**	**211,74**	**2**	**32,240**	**14**	**179,500**	**921,724,591**	**118,200**	**921,842,79**
Railways and Railroads	**13**	**20**	**1,178,15**	**18**	**1,150,155**	**2**	**28,000**	**2,711,878,239**	**1,544,975,443**	**4,256,853,68**

as follows:

0	372,219,000	472,911,000	99,308,000	1,891,000	10,617,000	(d)	d 204,722,000	4,951,000			314,334,000
0	517,942,000	492,419,000	25,523,000	2,958,000	58,972,000	(d)	d 320,680,000	33,208,000			38,615,000
0	507,655,960	476,855,715	30,800,245	750,206	65,004,893	63,473,252	233,954,438	25,494,523		13,601,293	21,678,219
885	448,880,000	432,306,000	16,574,000	2,424,000	48,224,000	(d)	d 213,463,000	26,018,000			63,497,000
0	357,959,000	352,335,000	5,624,000	631,000	38,383,000	(d)	d 204,977,000	19,595,000			21,046,000
65,666	346,829,000	192,127,000	154,702,000	1,186,000	26,866,000	(d)	d 170,392,000	11,473,000			69,322,000
0	339,545,000	339,537,000	8,000		35,792,000	(d)	d 134,436,000	22,865,000			109,666,000
0	258,441,774	167,671,574	90,770,200	5,597,867	27,414,663	25,876,070	128,862,960	874,712	4,057,962	1,796,281	17,289,104
0	240,613,000	234,607,900	6,006,000		43,691,384	(d)	d 109,335,952	24,578,379			28,455,772
0	234,397,900	234,397,900		0	0	0	0	0	109,625,650	0	124,743,800
0	229,654,309	225,326,616	4,327,693	1,017,805	24,865,634	22,354,264	44,264,624	6,229,399		24,381	81,318,106
0	220,277,035	180,780,319	39,496,716	692,634	28,167,346	35,030,466	94,510,517	7,655,234		5,979,296	9,980,504
0	218,847,118	187,969,652	30,877,466	1,040,421	33,591,643	17,786,988	107,023,264	7,595,051		1,548,890	16,897,030
15,000	209,740,473	175,630,213	34,110,260	6,093,331	27,743,971	34,022,762	49,585,155	8,063,431			8,035,898
700	178,991,700	130,114,700	48,877,000	1,333,157	28,356,719	66,333,748	38,514,478	1,893,258			11,369,153
0	103,776,867	103,613,067	163,800	806,675	13,855,924	19,974,453	40,875,158	1,004,583	109,372	5,859,980	6,586,944
82,251	4,985,771,036	4,398,602,656	587,168,380								
294,500	1,292,318,000	1,263,165,000	29,153,000	2,533,000	41,042,000	(d)	d 821,977,000	152,518,000			81,035,000
168,542	564,307,000	362,267,000	202,040,000	7,746,000	58,585,000	(d)	d 343,749,000	17,273,000			37,708,000
81,575	434,959,000	406,104,000	28,855,000	19,130,000	34,080,000	(d)	d 78,580,000	10,042,000			220,091,000
37,055	354,295,874	349,709,974	4,585,900	2,529,916	52,063,407	47,634,484	150,449,661	9,052,500	25,561,608	31,838	3,412,323
70,050	260,516,149	231,516,995	28,999,154	6,741,845	0	0	0	0	90,796,423	0	85,995,581
651,722	2,906,396,023	2,612,762,969	293,633,054								
876,794	4,463,309,951	3,425,983,055	1,037,326,896	519,751,757	487,945,843	349,204,673	1,468,865,062	56,523,682	0	240,940,932	177,754,948
488,640	3,139,306,603	3,118,016,988	21,289,615	346,629,643	276,099,434	189,816,372	778,298,561	33,667,987	w 13,690,987	242,655,361	645,990,734
209,775	914,812,000	908,171,000	6,641,000	37,318,000	126,916,000	174,623,000	228,084,000	29,976,000		53,350,000	25,968,000
144,910	854,380,000	473,650,000	380,730,000	19,050,000	87,032,000	(d)	d 338,070,000	29,544,000			229,609,000
110,605	798,261,643	266,155,100	b 532,106,543	0	122,913,803	314,623,276	195,793,469	54,916,361	0	0	0
93,730	583,071,000	552,011,000	31,060,000		98,434,912	68,628,260	214,208,652	24,628,781		53,446,435	15,731,683
100,080	515,252,331	505,809,131	9,443,200		36,487,318	12,995,884	58,391,387	2,197,640			319,106,117
83,300	507,977,590	507,977,590	0								473,890,200
0	437,156,341	428,859,727	8,296,614		M 200,569,349	(M)	M 119,939,050	4,837,048			53,554,322
58,624	365,072,000	365,072,000	0								365,072,000
60,825	355,878,311	O 266,914,099	88,964,212	41,074,889	20,292,063	32,371,648	137,336,551	671,853			21,243,043
9,600	351,536,000	124,588,000	226,948,000	2,665,000	37,820,000	(d)	d 228,121,000	4,632,000			30,701,000
97,500	349,967,300	338,529,300	11,438,000		86,101,559	62,567,772	65,105,155	18,808,585		31,301,069	3,000
114,000	276,098,322	275,939,322	159,000		45,633,247	44,609,618	113,117,060	8,903,598		852,800	17,081,555
21,467	243,266,000	144,401,000	98,865,000	18,188,000	46,172,000	(d)	d 70,935,000	10,999,000			41,141,000
0	205,337,598	202,625,775	2,711,823		40,829,369	41,255,744	55,043,846	11,978,162		15,442,000	6,401,120
46,900	191,918,000	191,918,000	0								191,856,000
34,000	153,917,750	153,522,950	394,800	(P)	(P)	(P)	P 61,398,417	(P)	(P)	0	78,516,230
2,550,750	14,706,518,740	12,250,144,037	2,456,374,703								
1,014,200	6,954,453,468	4,803,361,582	2,151,091,886								
619,150	4,777,711,082	3,696,755,786	1,080,955,296	2,206,944	28,789,484	20,402,636	1,926,640,442	4,084,370	Q 1,826,031,529		603,185,085
486,245	2,843,388,706	2,841,002,183	2,386,523		19,400,000	10,170,346	1,594,621,190	1,202,300		3,230,340	1,148,264,530
330,000	2,220,640,856	2,206,304,856	14,336,000				1,556,732,893				628,012,924
215,410	2,071,625,524	829,672,900	1,241,952,624		115,392,045	189,004,562	847,955,490	17,653,162	S 582,415,540	119,956,023	22,870,310
169,825	916,891,229	916,891,229	0	1,147,006	3,350,075	1,884,684	811,136,020	415,293			5,201,355
200,000	832,239,594	832,239,594	0		293,594		725,757,300				15,453,000
311,000	825,901,000	825,901,000	0				75,824,000				742,730,000
251,058	657,958,100	657,958,100	0		94,393,889	39,258,267	120,006,166	1,713,176	137,306,165	37,278,546	127,431,294
94,375	577,265,540	476,640,540	100,625,000		14,147,869	7,397,011	506,046,695	859,204			
96,234	552,752,450	444,220,950	108,443,500		186,685,374	74,323,766	47,413,424	14,954,272	U 167,386,400		592,560
75,000	525,570,000	525,570,000									
167,325	417,787,590	417,787,590	0		77,198,126	55,833,282	146,072,916	10,919,162		81,051,864	6,399,793
45,000	281,557,016	281,557,016	0				279,833,016	1,724,000			
39,200	241,458,062	241,458,062	0	36,489	131,748	67,961	216,598,307	42,444		1,193,512	15,745,800
80,000	239,609,370	239,609,370									237,844,220
62,955	216,227,296	O 216,227,296			c 458,698	(c)	156,544,738	46,547			47,631,432
43,865	203,264,130	174,673,730	28,590,400	675,000	13,630,000	7,730,000	91,275,760	3,650,000	16,555,200		58,669,800
45,000	193,833,300	193,833,300									193,833,300
53,000	144,956,182	143,595,320	b 1,360,862	228,076	3,049,002	5,775,870	10,356,248	1,167,813			101,846,637
4,398,842	25,695,090,495	20,965,260,404	4,729,742,091								
179,500	921,842,791	921,724,591	118,200		50,262,416	26,376,322		55,750,752	R 378,457,401	72,081,924	
0	1,158,592,929	1,158,468,700	124,229								
0	622,972,653	0	622,972,653								
0	597,495,776	597,495,776	0								
0	356,189,680	307,968,530	48,221,150								
0	302,650,740	0	302,650,740								
0	224,417,750	224,417,750	0								
0	220,871,582	161,137,582	59,734,000								
0	164,550,700	83,069,800	81,480,900								
12,000	141,028,510	4,852,610	136,175,900								
0	133,734,406	0	133,734,406								
16,000	124,673,675	91,216,550	B 33,457,125								
0	117,657,031	83,250,941	34,406,090								
0	92,018,250	0	92,018,250								
28,000	4,256,853,682	2,711,878,239	1,544,975,443								

Summary of Gene

Section	Number of Companies or Systems	Number of Generating Plants and Gener — All Plants — No.	Rating Kw.	— Fuel Plants — No.	Rating Kw.
United States	**140**	**1,784**	**30,494,993**	**879**	**21,653,592**
New England	14	167	2,242,117	42	1,531,177
Middle Atlantic	21	325	8,808,626	137	6,962,181
East North Central	29	296	7,043,714	151	6,664,376
West North Central	13	187	2,195,222	111	1,625,149
South Atlantic	14	219	2,660,441	110	1,430,560
East South Central	10	120	1,424,644	96	604,643
West South Central	16	190	1,474,303	175	1,392,052
Mountain	5	91	768,519	21	116,797
Pacific	18	189	3,877,407	36	1,326,657
Canada	**20**	**135**	**4,496,87**	**10**	**98,030**
Mexico	**1**	**16**	**211,74**	**2**	**32,240**
Railways and Railroads	**13**	**20**	**1,178,15**	**18**	**1,150,155**

000		63,509,000	398	91,111	(d)	d	17,620	549			17	102
219	3,060,446	80,638,690	526	105,255	23,410		8,754	1,572		2	20	103
000		95,254,000	1,900	84,063	(d)	d	23,220	1,441			19	104
000		73,327,000	456	62,249	(d)	d	12,431	588			22	105
000		67,590,000	1,751	46,363	(d)	d	14,202	1,006			12	106
000		36,786,000		77,468	(d)	d	15,424	520			8	107
104	7,331,142	39,341,013	199	37,325	8,343		348	29	24	1	13	108
772		34,552,513		61,551	(d)	d	9,451	278			2	109
300	0	28,450	0	0	0		0	0	2	0	1	110
106	8,068,763	41,511,333	910	C 31,622	C 11,187		892	586		1	5	111
504	5,958,842	32,302,196	1,031	47,078	11,611		1,863	322		1	7	112
030	1,820,080	31,543,751	847	50,230	10,036		2,248	487		2	4	113
398	22,355,076	53,840,849	1,412	39,943	14,812		764	333			8	114
153	1,066,609	30,124,578	987	54,363	10,508		227					115
944	1,021,738	13,682,040	455	17,651	3,365		216	4			2	116
000	21,845,000	171,368,000	2,039	59,592	(d)	d	11,225	972			9	117
000		99,246,000	11,906	75,134	(d)	d	10,701	1,010			23	118
000		73,036,000	10,407	29,275	(d)	d	6,003	696			9	119
323	4,007,450	59,552,687	2,739	98,654	15,339		6,356	59	9		5	120
581	37,673,133	39,309,167	4,789	0	0		0	0	336	0	11	121
948	70,104,633	1,092,218,421	35,236	618,050	90,507		37,634	680	0	15	33	122
734	4,855,997	607,601,527	14,552	399,997	51,992		21,977	364		3	11	123
000	5,082,000	233,495,000	25,031	121,492	21,589		635	230		5	14	124
000		151,075,000	5,296	53,155	(d)	d	9,014	864			16	125
0	7,023,990	102,990,744	0	a 196,871	a 43,903	a	2,182	a 698				126
683	3,676,819	104,315,458		95,556	11,940		183	443		5	5	127
117	3,467,374	82,606,611		21,805	4,378		1,389	96			7	128
200	2,506,405	31,580,985									1	129
322	5,537,781	52,718,791		M 153,481	(M)	M	10,125	282			1	130
000											1	131
043	8,952,470	93,935,794	1,373	24,220	7,691		46	30			9	132
000		47,597,000	4,108	32,577	(d)	d	5,876	191			7	133
000	13,422,650	72,657,510		80,087	11,496		2,919	286		6	1	134
555	1,115,740	44,784,704		29,236	4,906		75	131		1	12	135
000		55,831,000	8,951	36,698	(d)	d	7,603	772			7	136
120	3,135,551	31,251,806		64,617	11,958		4,895	33		1	4	137
000		62,000									3	138
230	563,550	13,439,553	(P)	(P)	(P)	P	14,651	(P)	(P)	0	2	139
												140
085	5,860,129	360,510,463	7,663	39,790	12,623		342	257	Q 19		13	141
530		66,500,000		18,129	3,196		20	92		1	11	142
924		35,895,039					4				4	143
310		176,378,392		208,132	40,648		418	26	S 10	1	7	144
355	1,036,057	92,720,739	28	4,040	790		22	6			6	145
000		90,735,700		13			4				2	146
000		7,347,000					5				2	147
294	12,446,485	88,124,112										148
		48,814,761		12,851	2,848		55	13				149
560		61,396,654		40,444	6,047		(V)	6	U 2		1	150
												151
793	7,885,591	32,426,856		83,520	14,394		2,820	16			2	152
							1	1				153
800	425,184	7,216,617	90	241	91		16	3		1	1	154
220	1,765,150										1	155
432	960,312	10,585,569		c 1,237	(c)		14	2			12	156
800	1,235,140	9,843,230	1,320	18,153	4,301		594	115	1		5	157
300											1	158
637	470,202	22,062,334	292	7,565	4,920		10	97			10	159
	7,876,660	331,037,316		132,198	44,200			1,138	R 10,014	1		160

Generator Rating and Output

Generator Ratings—Hydro Plants—No.	Generator Ratings—Hydro Plants—Rating Kw.	Energy Generated (Net), Kw.-Hr.	Energy, Purchased, Kw.-Hr.	Total Output Gen. and Purch. Kw.-Hr.
905	**8,841,401**	**86,694,511,475**	**16,200,413,715**	**102,894,925,190**
125	710,940	5,631,405,591	1,473,551,065	7,104,956,656
188	1,846,445	25,157,432,175	3,309,066,203	28,466,498,378
145	379,338	21,464,123,601	4,386,296,799	25,850,420,400
76	570,073	5,793,941,657	161,709,958	5,955,651,615
109	1,229,881	5,792,762,633	2,442,127,862	8,234,890,495
24	820,001	3,593,336,156	1,090,485,691	4,683,821,847
15	82,251	4,398,602,656	587,168,380	4,985,771,036
70	651,722	2,612,762,969	293,633,054	2,906,396,023
153	2,550,750	12,250,144,037	2,456,374,703	14,706,518,740
125	**4,398,842**	**20,965,260,404**	**4,729,742,091**	**25,695,090,495**
14	**179,500**	**921,724,591**	**118,200**	**921,842,791**
2	**28,000**	**2,711,878,239**	**1,544,975,443**	**4,256,853,682**

NOTE—Several of the regional totals, notably the East North Central and the South Atlantic, are not comparable with those of earlier years, owing to the grouping of companies formerly listed separately and the omission of a few companies which did not report.

as follows:

Co. No.	No. of Plants	Kw.
2	1	50 (Hydro)
4	1	23,000
15	5	50,000
38	2	750 (Hydro)
47	1	18,000 (Fuel)
71	1	50,000
73	1	600
75	1	370
85	1	7,500 (Hydro)
120	2	3,600
123	1	1,800
128	1	15,000 (Fuel)
132	2	2,250 (Lsd.)
	2	7,700 (Resv.)
136	1	1,100 (Hydro)
159	1	12,975 (Fuel)
171	2	16,000 (Hydro)

Companies reporting contract power, generally in addition to leased plants, were—

Co. No.	L's'd Pl.	L's'd Kw.	Contr. Kw.
43	..	....	31,060
46	..	....	7,500
77	5	5,715	115,200
78	7	3,778	22,250
91	1	8,000	45,500
92	1	3,000	5,000
99	..	....	4,950

Leased plants *additional* to reported generator rating were—

Co. No.	No. of Plants	Kw.
49	2	16,900
106	2	390
118	5	28,000
124	1	5,500(Hydro)

Leasing to others:

65	3	47,253

M Domestic and commercial light, incl. incidental power, are combined under Domestic; power under Commercial (wholesale). No. of active meters given under Customers.

N Includes Nevada-California Power Co., Southern Sierras Power Co. and Yuma Utilities Co.

O Gross generated.

P Cols. 10-15 combined; also Cols. 20-25.

Q Electric boilers.

R Includes domestic and com'l flat rate customers.

S Secondary or dump power.

T Standby.

U Off-peak.

V 1,497 customers included in other groups.

W Includes Manitoba Power Co., Ltd., Northwestern Power Co., Ltd., Winnipeg Selkirk & L. Winnipeg Ry., Suburban R. T. Co.

X Kv.-a.

Y Mainland system only.

Z Horsepower.

ELECTRICAL WORLD

FOUNDED IN 1874 ✦ ✦ READ BY ELECTRICAL MEN FOR SIXTY YEARS

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PAUL WOOTON, Washington Correspondent — C. R. PACE, News Editor — C. W. LEIHY, Pacific Coast Editor

Reader's Guide to This Issue

ELECTRICAL WORLD'S annual supplement of 100,000,000-kw.hr. companies, in this issue, presents vital statistics on the 1935 production of 174 major utility systems in North America. Nowhere is more reliable information on generation, output customers and allocation of energy to be found in like detail. Information presented lends itself to studies of the trend in output and peak load since it covers the period of years from 1928 to 1935, inclusive. Here ELECTRICAL WORLD presents proof to support contentions that margins of capacity are decreasing and that domestic and commercial and industrial energy consumption is increasing.

•

Of Executive Interest

Operation of 100,000,000-Kw.-Hr. Utilities — Sinking Fund Best for Hydro—Load Building Without Merchandising — Utilities Hold Gains Over 1935—Carter Field on Washington Events.

•

For Power Company Engineers

Bus Protection Gives Reliability —D.C. Transmission in France —Meter Catches Transformer Loads—Glareless Street Lighting—Operations of 100,000,000-Kw.-Hr. Utilities.

•

On Power Company Sales

Glareless Street Lighting—Electrified Hotbeds Yield Pre-Season Plants—Load Building Without Merchandising — Utilities Hold Gains Over 1935—Operation of 100,000,000-Kw.-Hr. Utilities.

•

For Electrical Engineers

Glareless Street Lighting—Laundry Data Sheets—Bus Protection Gives Reliability—Electric Stripping Shovel for Mine.

•

For Electrical Manufacturers

Glareless Street Lighting—Electrified Hotbeds Yield Pre-Season Plants — Bus Protection Gives Service Reliability—Load Building Without Merchandising—Meter Catches Transformer Loads.

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Coming Features

The Industry Today

In keeping with the importance of the coming E.E.I. convention at St. Louis, which heralds as it does the marked upturn in the affairs of the electrical industry, a pre-Convention Number of ELECTRICAL WORLD will be presented on May 23. A full report of the convention will follow in the Report issue of June 6.

In the pre-Convention Issue a balanced editorial report will be presented on the status of industry activities, which will give an interpretation of industry problems and a record of new practices. Leaders in thought and action in the several fields will be asked to give us facts and opinions to help in the preparation of the reports, which will be both authoritative and factual.

Current aspects of industry activity in the fields of generation, transmission, distribution, industrial electrification, domestic, commercial and industrial load building will be fully discussed, together with the current rate situation, legislation and the courts and management policies.

An editorial report showing the trend in the year's products will give an unbiased discussion of the developments in equipment that have made recent technical advances in the utility industry possible.

•

Nation's Power Supply Under Private Enterprise

An extensive abstract of Frank F. Fowle's paper "The Nation's Power Supply; Its Economic Development Under Private Enterprise," which attracted wide attention in the industry when presented before the Midwest Power Engineering Conference in Chicago recently, will also be a special feature of the E.E.I. pre-Convention Number.

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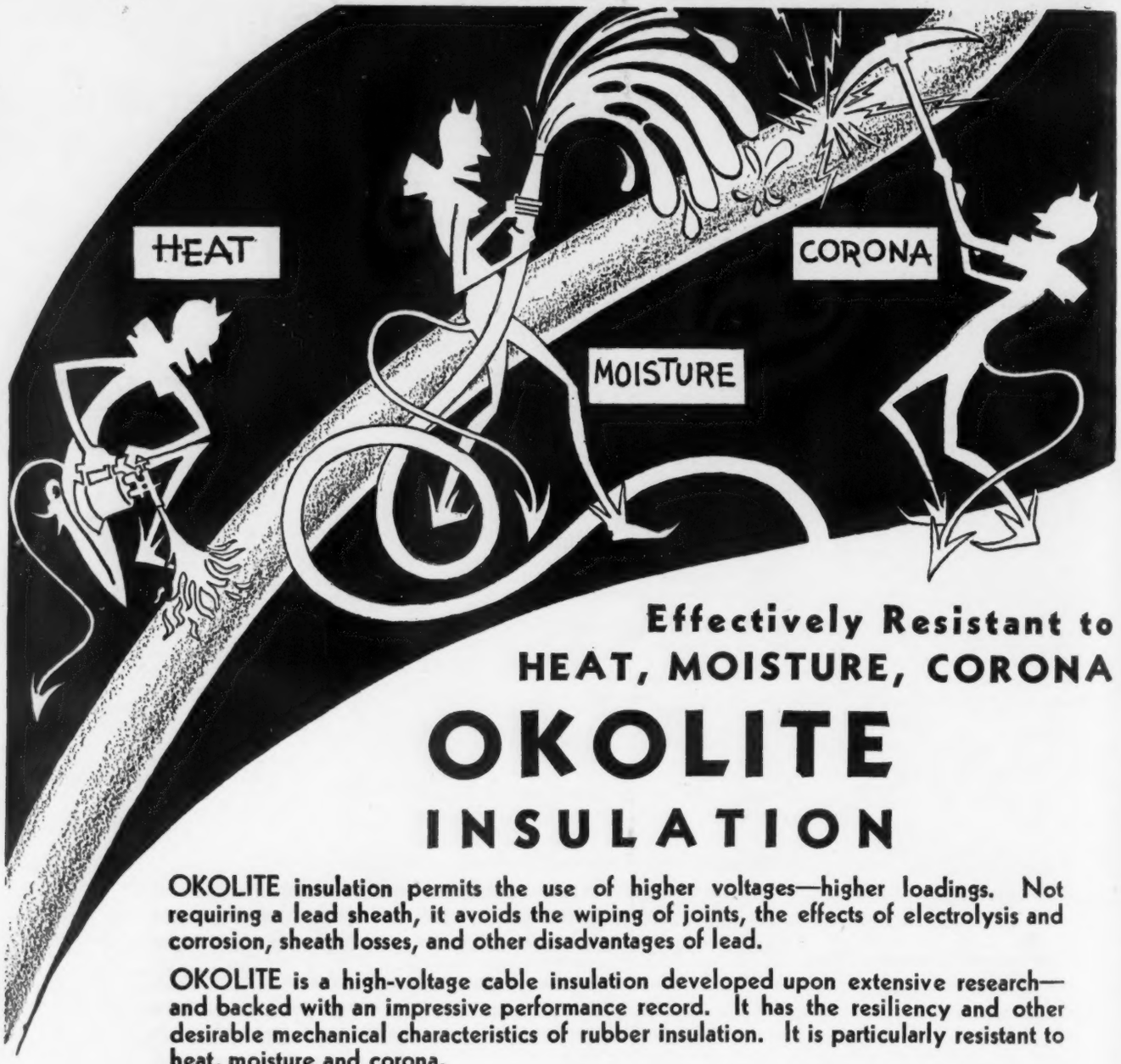

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LETTERS TO THE EDITOR

Dealers Won't Sell

To the Editor of ELECTRICAL WORLD:

May I have a little space in your valuable magazine to call attention to the humorous inconsistency of the last paragraph in your editorial entitled "The Dealer Now Builds Half the Range Load."

The difference is quite true. The dealer sells half the range load, not from his own initiative, but because he is spoon-fed with prospects, financed by the utilities, prodded by the utility load-building departments, threatened by promotional executives and finally compelled to accept the prospect's order for a range because he (the prospect) must have something to cook the next meal with, since his previous cooking equipment has simply become impossible.

I know there are exceptions to every statement, but on the average the dealer in electrical appliances is no salesman and will not exert himself to become acquainted with quality merchandise and takes the line of least resistance by selling a price article, trusting to luck that he will get by, instead of selling the best dollar value and thereby establishing the purchaser's confidence in his retail organization.

The second paragraph of your editorial, which gives certain details of sales, should have carried the additional information that many of the ranges sold latterly were actually sold by utility salesmen and the deal put through a dealer outlet.

It is safe to say that if the utilities ceased all sales activity and the manufacturers simply filled dealers' orders, omitting any promotional assistance beyond their present practice, this class of utility energy sales would drop by 30 per cent in the next three years.

H. F. SHEARER,
Manager
Welland Hydro-Electric System.

Mr. Shearer is a little hard on the dealer. There is another side to the story. Our contact with dealers in all sections convinces us that they are good business men and good merchandisers, but that they exist on the lower round of the commercial ladder. They claim that margins will not permit them to go out and pioneer special products, that they are by-passed by manufacturer and jobber on large orders and that they are not treated fairly. Dealers should be helped and encouraged. The more sales outlets the greater the service and sales volume.—EDITORS.

•

Municipals Under Commission

To the Editor of ELECTRICAL WORLD:

I have been a consistent subscriber of the ELECTRICAL WORLD and other McGraw publications for many years. Consequently, I have profited educationally, I assure you.

Wallace A. Rogers' article, "Municipal Electric Service," in the March issue of the ELECTRICAL WORLD prompts me to write you in a general way, not to draw illustrative comparisons between utilities, I assure you, but to show what regulatory measures will accomplish.

I assume it is not out of order to mention that there are 86 municipal utilities operating in the State of Wisconsin, and to my best knowledge and belief they are all in a healthy condition. However, it is my belief that this has been brought about by the regulatory powers exercised by the Public Service Commission of Wisconsin, and it is our opinion that were it not for the regulatory powers vested in commissions here in Wisconsin there would be fewer municipal properties in operation, and none, perhaps, in as good a condition.

GEORGE MARVIN,
Superintendent,
Marshfield Electric and Water Dept.,
Marshfield, Wis.

•

Queries Fan Motor Formulas

To the Editor of ELECTRICAL WORLD:

An interesting article appears on page 27 of the ELECTRICAL WORLD for February 15, 1936, bearing on the above subject. There is one place in particular which is not clear to me. I refer to the tabulation appearing on page 27 which contains data for substituting in the formula: $t = \frac{WR^2N}{308T_a}$. The values given in the tabulation for T_a are 4.1, 2.1, 2.6, 3.6, 2.0, 1.0, 1.2 and 2.2. Substituting these values in the above formula does not seem to give the correct values for t. I presume it is intended to subtract the torque values for the fan load as given in Fig. 1-b from the motor torque value, and I estimate these values would be as follows: 6, 12.1, 21, 28, 41.5, 50, 49.5, 41.5 and 16. Substituting these values in the formula in place of those given in column 3 of the tabulation will give the correct result for t in column 4. I think the method of calculating is correct, but somehow the values for acceleration torque in pounds as given in the tabulation are incorrect.

I think that the author has treated his subject very nicely and I have read the article with much interest, but if there is anything in regard to the accelerating torque which has escaped me I would be glad to have some one put me right.

N. B. BENEDICT,
Scotia, N. Y.

To the Editor of ELECTRICAL WORLD:

The values given for T_a are, as mentioned, incorrect. They belong to an intermediate step in the calculations not included, and were copied by mistake. Below is given the tabulation, with correct values for T_a:

$$t = \frac{WR^2N}{308T_a}$$

1. Final R.P.M.	25	50	100	200	350	450	500	550	585
2. N	25	25	50	100	150	100	50	50	35
3. T_a	6	12	21	28	41.5	49.5	50.5	41	16
4. t	8.9	4.4	5.1	7.6	7.7	4.3	2.1	2.6	4.7

There is another error which we believe should be mentioned and that is in the formula on page 71. As shown, the WR^2 is divided f (frequency), whereas it should be multiplied. This is shown correctly in the example given, however.

The values given for T_a above do not agree exactly with those figured by Mr. Benedict, as he probably figured them from the final results or values of t and our figures are from the original curves.

We are sorry that this mistake crept into the tabulation as it naturally makes it more difficult for the layman to be sure of his grounds when using the formula.

R. C. ALLEN,
District Engineer
Westinghouse Elec. & Mfg. Co.,
Philadelphia, Pa.

[Mr. Benedict has also called our attention to the fact that figure numbers were a bit garbled. Fig. 26 (cited on page 28) should be read 1b, Fig. 3 should be read Fig. 2 and Fig. 4 should be read Fig. 3. —EDITORS.]

•

Electric Fences Old

To the Editor of ELECTRICAL WORLD:

I am inclosing a clipping from the February 22 issue of the ELECTRICAL WORLD. The item which I have marked, headed "Electricity Keeps Cows in Home Pastures," is interesting and perhaps struck you as something new in the use of electricity. However, the idea is by no means new, as I remember very distinctly of a pasture surrounded by charged wires as early as before 1895, which is more than 41 years ago. This pasture held stock and the fence was very effective.

I do not know the voltage which was used, but I remember that there were many parties formed to make a trip to the electric fence. Several people would stand on boards, with one person touching the fence wires. Then when the person at the other end of the string would step onto the ground all would feel a shock. We increased the shock's severity by having fewer and fewer persons in series between the wire and the earth. At the time, this was quite a social function to form a party to be entertained by getting a shock from the "electric fence."

There was also a fence around a smaller lot in the village. This smaller fence was used for advertising and demonstrating purposes. I do not know what became of the company which manufactured this fence and I know nothing about how many other fences were installed, but the one mentioned above seemed to be very effective. Stock inclosed in the pasture outside of town as well as that in the demonstrating fence in town soon learned to keep away from the fence.

ROY H. DILLON,
Illinois Power & Light Co.,
Decatur, Ill.

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Use Good Neighbor Rural Policies

A trip about the country, as well as an enormous publicity program, shows the extraordinary interest in rural electrification. Private utilities now, as in the past, are setting the pace in actual accomplishment. But several R.E.A. projects are now approved and county agents and contractor-promoters are bringing many others to the approval stage.

What policy should private utilities follow with respect to these R.E.A. projects? To date most private companies have leaned backward in co-operating with this activity. In several instances they have agreed to the R.E.A. requests that they refrain from competition. An exception to this policy was taken down in Virginia recently by the state commission, which ordered a private utility to build a rural line despite such a non-competitive agreement.

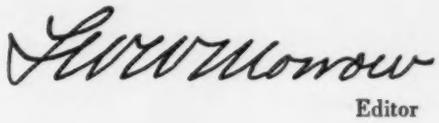
It is the general practice of the private utilities to build their own rural lines as rapidly as possible and yet co-operate with the R.E.A. promotional programs. But the time will come soon when some of those co-operatives will be built. Who will operate and maintain them? The county agents, the contractor and the farmers are unskilled in this work. Would it not be neighborly as well as good business for the utilities to take over all responsibility for those co-operatives except the investment burden? The utilities know how to operate and how to maintain rural distribution. They know how to build rural use and make sales to farmers.

Possibly the adoption of this policy could be embodied in a contract form that covered wholesale rates as well as operation. Past experience with co-operative rural lines shows that they are failures under farmer operation. Thus if the farmers attempt to operate themselves undoubtedly the pressure will increase over the years to get utilities to supply wholesale energy at less than cost. Even now this pressure exists.

Rural electrification is a practical business activity of major magnitude if considered in all its aspects and private utilities should formulate policies based upon a broad conception and a long period perspective. We believe careful consideration will lead to the adoption of the "good neighbor" policy.

Good signs of a revived and more prosperous industry are found in two things. One is the almost universal report that all electrical business is in good volume and promises to get even better. The other is the revived interest in the regional and national meetings of the several branches of the industry. The programs are vitalized, the attendance is good and the whole atmosphere gives an impression of courage and enthusiasm.

When one considers the local and national problems and troubles of the industry and the difficulty of making long-term business plans it is remarkable to find the come-back now being staged by electrical men. It is a tribute to their courage, their resiliency and their faith that they can overcome all obstacles with the magic they produce for humanity.



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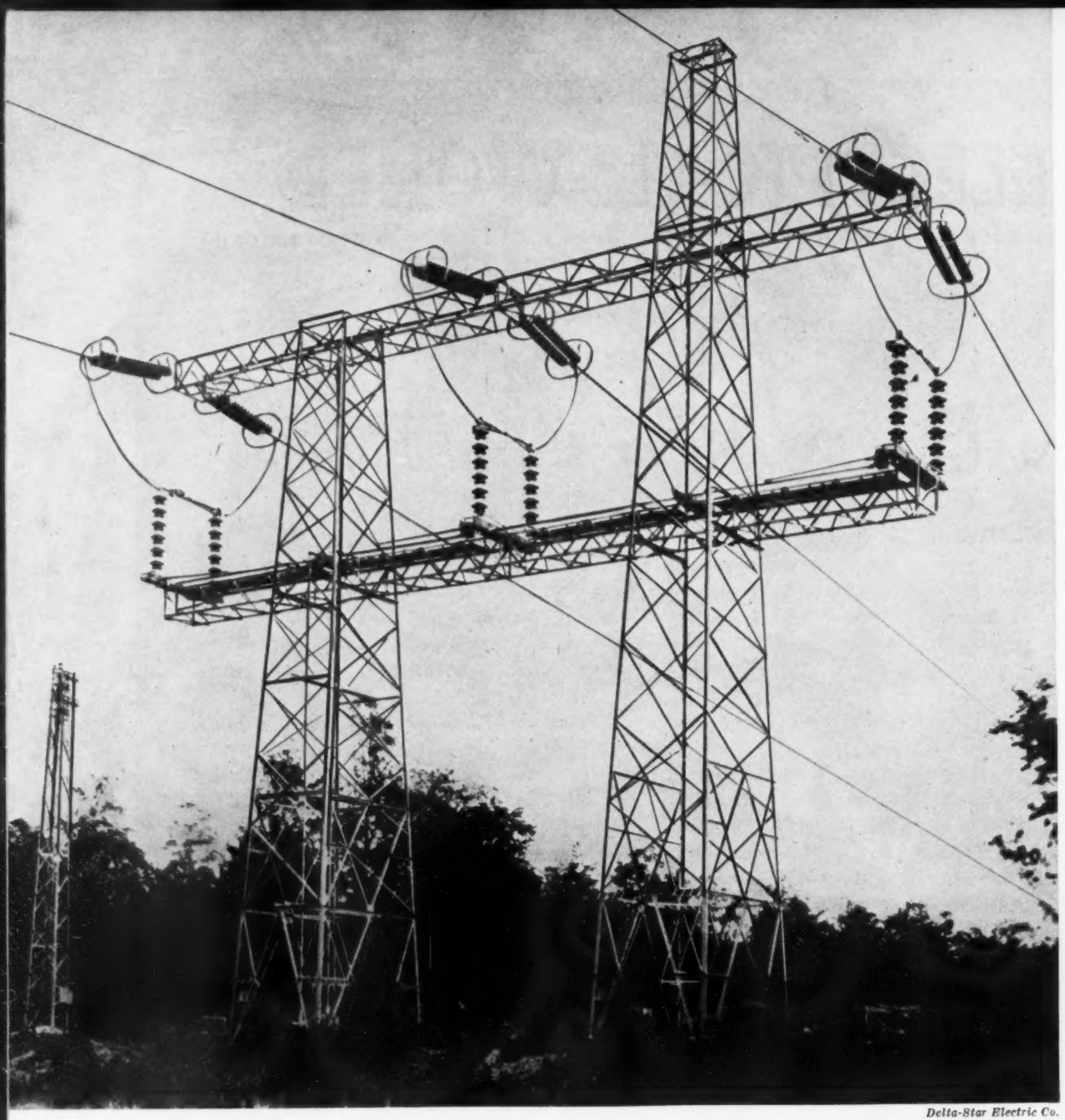


Delta-Star Electric Co.

POWER FOR PARIS

This motor - operated three - pole switch is installed on a 220-kv. line near Dijon which connects the Henri-Paul substation, receiving power from hydro stations of the Alps region, to a substation at Creney, from which lines extend to Paris. The switch is controlled from a point 2 km. (about 1¼ miles) from the tower.

1935 Operations of 100,000,000 Kw.-Hr. Utilities

Many Companies Exceeded Previous Records—Peaks, Output, Plant Factors Have All Increased, With Capacities Static Since 1931

This is a special statistical feature of "Electrical World" giving detailed data on operations of 174 leading utilities during 1934 and 1935. This article and the Supplement accompanying this issue were made possible by the cordial co-operation of the utility executives. These are basic data for the information of the industry.

PROGRESSIVE gains during the past several years in the operations of electric public utilities in the United States are a matter of record, in the form of group statistics. The Supplement accompanying this issue of ELECTRICAL WORLD brings details for 140 individual light and power systems in this country, twenty in Canada, one in Mexico and thirteen electric railways and railroads.

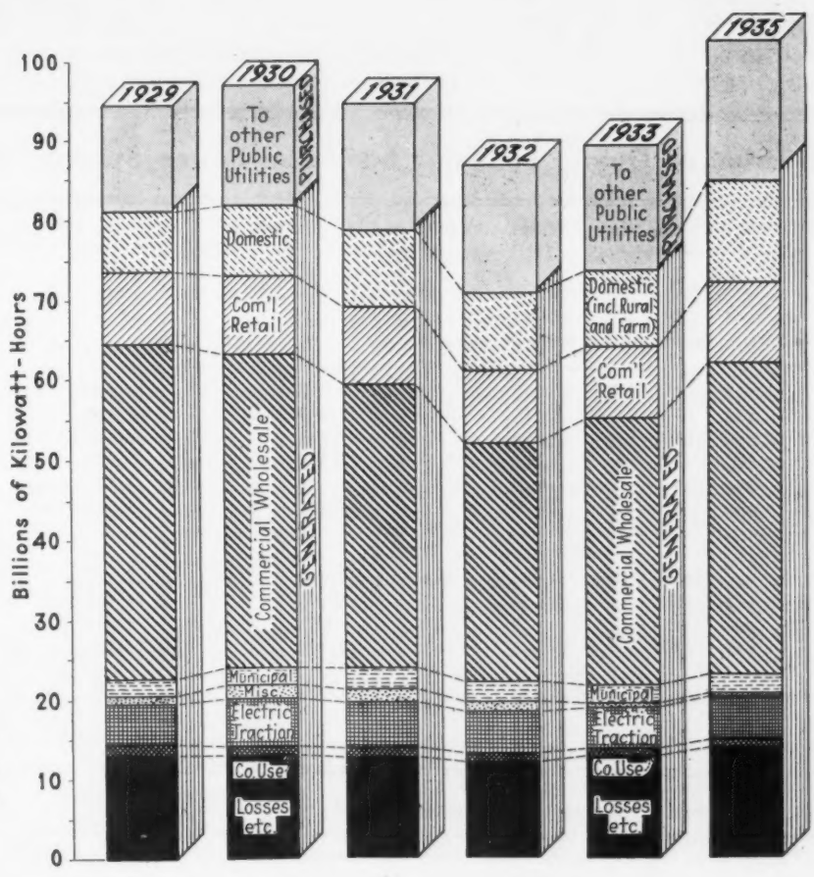
The first-named group constitutes 90 per cent of the electric light and power industry as to generating capacity and 93 per cent as to generated output. In this group there was a net increase of three systems compared with the figures for 1933, as a combined result of additions, grouping and missing reports. The aggregate rating, 30,494,993 kw. in 1935, was almost identical with the earlier 30,473,841 kw., but it was under the 30,678,632 kw. of 1932. The number of plants decreased from 1,884 in 1932 to 1,863 the next year and to 1,784 last year. This means that in three years 100 plants presumably obsolete have been eliminated.

Numerically the generating plants are almost equally divided between fuel-burning and water power, but the kilowatt rating of the latter is only 29 per cent of the total. These companies reported a generated output of 86,964,511,475 kw.-hr. and purchases of 16,200,413,715 kw.-hr., making a total of 102,894,925,190 kw.-hr. to be accounted for. The figures show large gains over those revealed by the last preceding survey, which covered operations in 1933 and of which the results were published in the ELECTRICAL WORLD of May 5, 1934 (about 73,818,000 kw.-hr. purchased, total 89,323,000,000 kw.-hr.) and they surpass those of any other year.

There were 30 companies in the billion kilowatt-hour class in 1935, 29 in 1934, 25 in 1933 and 23 in 1932. Because of grouping, several companies that formerly were separately listed now count as only one.

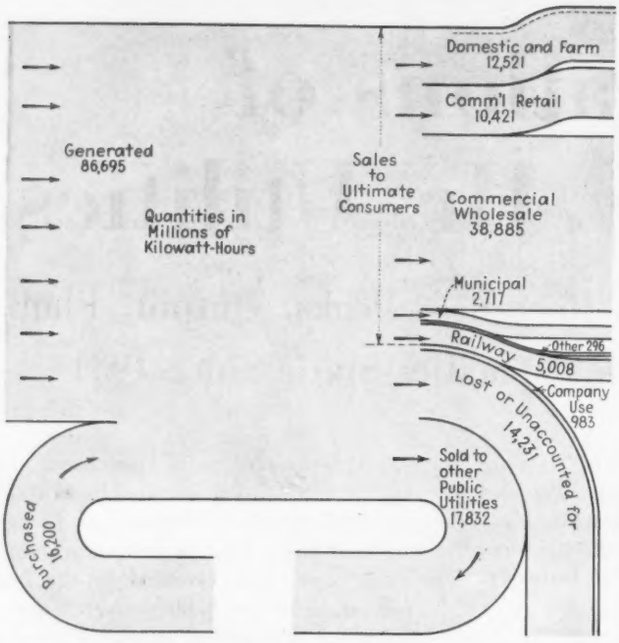
Heading the list, with a generated output of 5,851,207,177 kw.-hr., is the Niagara Hudson system. Next in order of magnitude is the Ontario Hydro, with a generated output of 4,803,361,582 kw.-hr., and third the Consolidated Edison group of New York, with 4,587,500,000 kw.-hr. If purchased energy is included the amounts are larger, as in Table I of the Supplement, but the same sequence remains. Combined they exceed all such plants in the United Kingdom.

With rising output the system and plant peaks of load have been getting



Wholesale energy sales lead all others

Comparative output of large systems over a seven-year period



Consolidated energy flow of 140 large systems in the United States

higher. As Table I shows, many companies in 1935 exceeded their 1929 and 1930 records in this respect. One instance calls for a special explanation. The Superpower Company of Illinois, operating a base-load station, reports a peak in excess of station rating, made possible because the peak was at 96 per cent power factor, while the rating corresponds to about 87 per cent. Meanwhile plant factors are rapidly approaching their former best values. Detailed comparison with the Supplements of earlier years would probably show a fair number of instances in which they are higher than ever before, as may be inferred from the regional averages in Table V.

Details regarding operations during 1935 are given in Table II of the Supplement. Capacities and output are summarized in the inserted table. Table III, below on this page, shows the changes in allocation of output of the light and power systems over a series of years. While the number of 100,000,000-kw.-hr. systems has varied somewhat, the yearly figures are closely comparable, with one proviso. Separate statistics on farm service were requested only in the surveys for 1933 and 1935. Prior to 1933 they were variously included under other heads, according to the judgment of the co-operating companies. In most regions they were probably combined with domestic. In the sections using power for irrigation, however, and especially in the Pacific States, where this application runs into large totals, they were generally listed under "Other Sales to Ultimate Consumers" or "Commercial, Wholesale." In Table III energy sold to farm customers in 1933 and 1935 was combined with domestic. Total farm energy separately reported by these companies for 1935 was very close to 1,300,000,000 kw.-hr., of which about 985,000,000 kw.-hr. was in the Pacific States.

Wholesale energy leads

Of total sales to ultimate consumers 55.7 per cent was for large light and power, 17.9 per cent for domestic use and 14.9 per cent for small light and power. The fraction of the total that goes to domestic consumers has greatly increased during the seven-year period. Commercial wholesale energy declined for some years, then recovered. It increased 17 per cent in 1935 compared with 1933. Energy sold for electric traction, though important for a number of companies, does not bulk large in the total. Despite recent steam railroad electrifications it has decreased every year since 1930. An approximate balance still exists between purchased energy and sales to other public utilities for resale, as might be expected, since these items are in most cases the two sides of the same trans-

Table III—Allocation of Output of Major Light and Power Systems, 1929 to 1935*

Class of Service	140 Systems in 1935			137 Systems in 1933			144 Systems in 1932			142 Systems in 1930			137 Systems in 1929		
	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales
Domestic†	**12,521**	12.2	17.9	**10,713**	12.0	17.9	**9,814**	11.3	17.0	**8,860**	9.1	13.1	**7,561**	8.0	11.3
Commercial retail	**10,422**	10.1	14.9	**8,911**	10.0	14.9	**9,089**	10.4	15.7	**9,836**	10.1	14.5	**9,184**	9.7	13.7
Commercial wholesale	**38,885**	37.8	55.7	**32,370**	36.2	54.1	**29,993**	34.6	51.8	**38,934**	40.2	57.3	**41,752**	44.1	62.5
Municipal	**2,717**	2.6	3.9	**2,261**	2.5	3.8	**2,512**	2.9	4.3	**2,501**	2.6	3.7	**2,230**	2.4	3.3
Other sales†	**296**	0.3	0.4	**449**	0.5	0.7	**1,231**	1.4	2.1	**1,572**	1.6	2.3	**971**	1.0	1.5
Railway operation	**5,008**	4.9	7.2	**5,179**	5.8	8.6	**5,234**	6.0	9.1	**6,209**	6.4	9.1	**5,149**	5.4	7.7
Used by ultimate consumers	**69,849**	67.9	100.0	**59,884**	67.0	100.0	**57,873**	66.6	100.0	**67,912**	70.0	100.0	**66,847**	70.6	100.0
Other public utilities	**17,832**	17.3	.....	**15,623**	17.5	.....	**15,690**	18.0	.....	**14,945**	15.4	.....	**13,290**	14.0	.....
Used by companies	**983**	1.0	.....	**948**	1.1	.....	**953**	1.1	.....	**1,019**	1.0	.....	**1,395**	1.5	.....
Losses, etc	**14,231**	13.8	.....	**12,868**	14.4	.....	**12,397**	14.3	.....	**13,225**	13.6	.....	**13,199**	13.9	.....
Total	**102.895**	100.0	.....	**89,323**	100.0	.....	**86.913**	100.0	.....	**97,101**	100.0	.....	**94,731**	100.0	.....
Company use plus losses in per cent of generated	.....	17.5	.....	.....	18.7	.....	.....	18.7	.....	.....	17.3	.....	.....	17.9	.....

*In each year the allocation in a few of the returns was incomplete and estimates had to be used. For 1931 see Suppl. May 5, 1934.
†For 1933 and 1935 farm or rural data separately reported have been combined with domestic. In earlier years farm energy was variously reported with domestic, as "other sales" or, especially in the West, as wholesale.

Table IV—Average Energy per Residential Customer, Kilowatt-Hours

Geographical Region	1935*	1933*	1932	1931	1930	1929
United States	**678**	**598**	**618**	**605**	**551**	**492**
New England	595	533	532	510	467	415
Middle Atlantic	593	525	537	538	483	441
East North Central	688	598	626	610	580	526
West North Central	695	608	621	590	545	501
South Atlantic	872	712	710	661	589	520
East South Central	752	583	616	592	530	440
West South Central	640	561	542	508	470	415
Mountain	762	687	706	702	692	556
Pacific	830	780	862	861	793	635

*Farm or rural customers, where separately reported, have been included with domestic except in the Pacific region. The figures for 1935 and 1933 are not exactly comparable with other years.

Table V—Changes in Regional Plant Factors 1927-1935

Generated Kw.-Hr. ÷ (Plant Kw. × 8,760) Expressed in per Cent

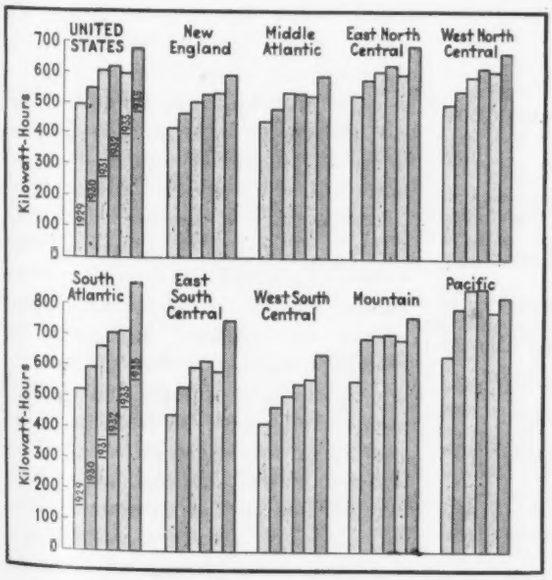
Region	1935	1933	1932	1931	1930	1929	1928	1927
New England	28.7	24.7	22.4	26.0	26.3	30.1	29.2	27.2
Middle Atlantic	32.6	29.3	29.4	32.3	34.7	37.3	35.0	33.7
E. North Central	34.7	28.0	26.1	29.6	31.5	35.1	35.3	35.7
W. North Central	30.2	25.7	25.9	28.6	32.7	34.1	32.8	31.1
South Atlantic	24.9	22.2	22.4	24.6	27.0	30.9	28.1	28.5
E. South Central	28.8	24.2	22.5	26.3	26.1*	27.6	27.1	31.2
W. South Central	34.1	29.1	28.6	33.2	38.6	41.9	35.2	38.5
Mountain	38.8	29.9	24.9	34.1	45.5	48.6	49.6	44.6
Pacific	36.0	31.1	31.0	35.5	37.8	41.1	39.2	40.6
United States	**32.5**	**27.6**	**26.6**	**30.3**	**32.7**	**35.9**	**34.3**	**34.1**
Canada	**53.2**	**43.4**	**42.7**	**44.4**	**51.1**	**61.7**	**55.2**	**57.2**

*Excluding 239,700 kw. available by lease or contract.

action. In 1935, however, the sales somewhat outweighed the purchases. The difference probably represents the excess of sales to smaller utilities, not comprised in the table, over purchases from sources outside of the light and power industry.

More domestic and farm use

In 1929 the average consumption per domestic customer of all reporting companies was 492 kw.-hr. per year. In 1935 it was 678 kw.-hr., or 38 per cent greater. Farm use was probably included in the earlier years except in the West, as previously explained. It was specifically included for 1933 and 1935 except in the Pacific States. Table IV gives regional details. Some of the apparently erratic variations can be explained only by comparing individual company reports for previous years.



Growth of average energy per domestic customer in major systems

Includes farm use except in Pacific States

Farm electrification has made its largest gains in the East, as Table VI shows. Some of the changes indicated by the reports for different years are not readily accounted for. On the Pacific coast the average per farm is fully ten times as large as in most other sections, largely because of the requirements for irrigation. The same explanation probably applies to the Southwest, which shows the second highest average.

Progress in Canada and Mexico

In Canada, unlike the United States, there was a pronounced increase in capacity. Twenty systems reported 4,496,872 kw. in 1935, against 4,117,367 kw. in 1933. Generated output rose to 20,965,260,404 kw.-hr. from the previous 15,844,759,365 kw.-hr. As these companies in a number of instances did not segregate sales by classes, no attempt has been made to work out Dominion averages.

In Mexico the one reporting company had the same plant capacity as in 1933, but the output rose from 725,351,101 kw.-hr. to 921,842,791 kw.-hr.

One group alone failed to participate in the general increase. Railway and electrified railroad plants show little change from previous operations, with one exception. The Pennsylvania Railroad's Long Island City plant increased its output about 50 per cent compared with 1933, but less energy was purchased.

Table VI—Average Annual Energy per Farm or Rural Customer

(Kilowatt-Hours)

Region	1935	1933
United States	**3,100**	**3,375**
New England	923	652
Middle Atlantic	962	823
East North Central	757	707
West North Central	810	827
South Atlantic	1,353	1,354
East South Central	946	901
West South Central	2,080	2,420
Mountain	1,213	1,215
Pacific	10,400	11,390

Because of smaller output one company formerly included does not appear.

Special features of individual reports

Several companies reported negative quantities under "purchased" energy, making the total output less than the generated. The meaning of this is that they interchanged energy with neighboring systems and reported the net of this interchange, which happened to result in a deficiency of receipts compared with their contributions.

In some returns, the designation of classes was changed, for example, from "domestic" to "residential," or "number of bills" was substituted for "number of customers." In Table II (Supplement) the items were entered under the most nearly corresponding head, without burdening the table with additional notes. "Free service" has been included in "company use." Federal, state and county building lighting is embraced in "municipal lighting." "Company use" is intended to designate energy for such use as company office and store lighting. In some cases energy used by gas, ice and other departments of composite companies was included.

"Glareless" Street Lighting

Objective Is City Street Illumination of Such Intensity and Quality as to Make Use of Automobile Headlights Unnecessary

By T. H. CARRITTE
City Electrician, Lynn, Massachusetts

LYNN, MASS., has recently decided to install approximately 260 multiple street lights to insure greater safety on certain residential thoroughfares by improving the distribution of illumination and doing away with glare both on the highway and against the bordering buildings. A portion of this installation is now in use on a 1,600-ft. stretch of Johnson Street, ten 300-watt General Electric form 79-A "Acorn" luminaires set 160 ft. apart (staggered) having been provided. The units are mounted on 6-ft. pole brackets and are hung 20 ft. 7 in. from street to light center. Even illumination results with high pavement brightness throughout the length of the street. Forty-eight other units are now in service on four other streets in this city.

The glare problem has been met by masking the light in the luminaire design so that it is unobjectionable to the gaze of motorists and free from complaint from the standpoint of persons occupying second and upper stories of residences. When the first installation was thrown into circuit Mayor J. Fred Manning of Lynn declared his intention to light all the city streets to a high enough intensity so that automobile headlights will be unnecessary at night. He pointed out that this should greatly reduce motor accidents and result in a much lower public liability insurance rate for Lynn. A long series of tests and sample demonstrations by the manufacturer of this equipment, with the co-operation of the Lynn Gas & Electric Company and other neighboring utilities, indicates that 40 per cent of the night fatalities in motoring could be prevented by proper street lighting. Lynn's night fatal accident rate last year was zero.

The principal factors back of the new installation were:

1. The luminaire gives a high utilization efficiency on the roadway without glare and has an excellent daylight appearance. This is obtained by using a patented hardening process (Alzak process) reflector which actually hides the lamp filament. This reflector forms the upper half of the unit and is spun on a patented self-cleaning rippled globe of one-third the usual size, giving a luminaire hermetically sealed against dust, rain and insects.

2. Existing poles and brackets can be utilized, lowering installation costs, and a lighter standard can be used for new installations.

3. The new light gives 50 per cent more illumination for the same cost to the city, and is therefore most advantageous to use in replacing low candlepower inefficient "bug" lights. We are replacing 200 of the latter 80-cp. "acorns."

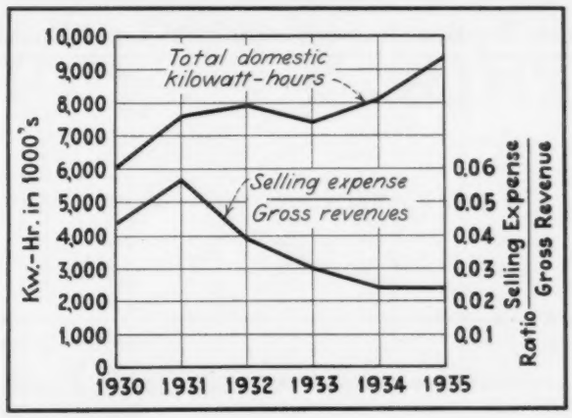
4. The visibility is increased 50 per cent because there is no glare. A definite cut-off, 15 deg. below the horizontal, shields the filament from the eyes of the motorist. The effect is that of floodlighting the street surface, and the cost of the luminaire is a favorable factor in communities considering modernization of their street lighting.

Johnson Street, Lynn, equipped with new multiple lamps designed to eliminate glare

Daylight view of glareless luminaire for street service

Because the light is confined to the street the value of silhouette effects for greater discernment is much increased. The taxpayer also derives considerable benefit from this type of lighting as it helps to keep prowlers away from the sides of houses and still illuminates the lower story effectively. The direction at which the light strikes the road contributes to the improved visibility.

In approaching the Johnson Street installation the impression is that one is in a well-lighted tunnel with the units concealed in the ceiling. Apparently there is no need for headlights. Details such as curbs, sidewalks, etc., stand out clearly and cars parked even two blocks ahead appear sharply in outline. Measuring the cost of accidents on the low level of money alone, it appears that the economic saving at Lynn from improved street lighting will reach three times the cost of this service, and we hope to reach a point when local newspapers will no longer use, in reporting night accidents, such phrases as, "Due to glaring headlights, poor street lamps and black asphalt, I did not see him until I was about 5 ft. away!"



Relationship between selling expense to the utility and growth of domestic kilowatt-hours

Load Building Without Merchandising

The Sierra Pacific Power Company, typical of thousands of small utilities in the country, solves the dilemma of adding load at lower rates without loss of revenue and without antagonizing the dealer. Policy of helping the dealer merchandise profitably has paid big dividends in high saturation of heavy-duty appliances.

TO THE typical small utility confronted with the problem of economically building domestic load without antagonizing the trade the successful plan worked out by the Sierra Pacific Power Company points the way to increased revenue and reduced selling costs. For the past three years this company has done no direct merchandising, but has co-operated in building an aggressive dealer organization in its territory. Since withdrawing from active merchandising the ratio of new-business expense to total gross revenue has decreased from 5.7 to 2.4 per cent and domestic kilowatt-hour sales have increased 19 per cent. Back of the plan was the reasoning of H. A. Lemmon, commercial manager, that a large number of prosperous electrical retailers could more aggressively and economically cover the scattered territory of the company than could a centralized utility sales force.

Profitable operations for more retail outlets were assured by the company turning over to the dealers all appliance merchandising and at the same time extending promotional aids in the form of advertising assistance, wiring allowances and reasonable bonuses for sales of heavy-duty appliances. Result has been an outstanding record of sales and load building as proved by a comparison of achievements under the new plan and when the company itself sold the bulk of the electrical merchandise.

Considering that there are only 8,908 domestic customers served by Sierra Pacific and that these customers are in a territory having something under 0.8 person per square mile, the sales achievements under the co-operative program are truly remarkable. In 1931 the Sierra Pacific Power Company was actively merchandising all types of appliances. With a staff of twelve salesmen and an office staff equally large it sold 399 electric ranges and 235 refrigerators, which brought the saturation for these two appliances up to 22 and 23 per cent, respectively. The average domestic consumption was 885 kw.-hr. at that time. The gross merchandising sales of approximately $200,000 were the largest that the territory had yet enjoyed.

An experience of value to the thousands of utilities with from 1,000 to 25,000 customers. A story of selling methods and results obtained at first hand. A story that may be the exception to the general opinion that co-operative merchandising will not work. Costs and returns are worthy of study by the industry.

By taking what was then the lion's share of the electrical appliance business, the company was unintentionally discouraging electrical merchandising in other retail outlets. Only five electrical dealers with but two appliance stores existed in the territory at that time. Contrast this situation with that of today, three years after Sierra Pacific's voluntary withdrawal from the merchandising field and after three years of successful dealer co-operation.

In November of 1935 the realization of a goal of 1,000 kw.-hr. average annual domestic consumption prompted a celebration of the utility and electrical dealers. Gathered around the banquet table were most of the 50 salespeople now engaged in selling electrical merchandise in the territory, representing the sales force of 26 dealers reporting appliance sales to the company. In three years time this dealer organization has raised the average electric range saturation to 42 per cent, exceeded by only two other utilities of the country, and has boosted refrigerator saturation to 44 per cent. In 1935 these dealers sold 686 ranges and 857 refrigerators, and the total of all appliance sales, including radio, for this territory with only 8,908 domestic customers, exceeded $600,000 for the year. This record in domestic consumption has been achieved without the promotion of electric water heating because the util-

Table I—Results of Residential Load Building on Lines of Sierra Pacific Power Company

Year	Domestic Customers	Elec. Range Sales	% Range Saturation	Refrig-erator Sales	% Re-frigerator Saturation	Water Heater Sales	% Water Heater Saturation	Domestic Residential Kw.-Hr. Sales	Average Annual Domestic Kw.-Hr.	Domestic Revenue	Average Annual Domestic Revenue	Average Rate (¢) Domestic Residential Kw.-Hr.
1930	8,186	294	16.5	296	19.8	...	...	6,022,622	781	$326,372	$42.53	5.65
1931	8,472	399	22.0	285	23.0	...	...	7,597,672	885	385,294	44.71	5.52
1932	8,031	353	26.0	393	28.6	...	8.7	7,857,789	923	392,437	46.09	5.44
1933	8,191	390	29.8	291	31.3	50	9.3	7,418,822	893	361,990	43.58	5.14
1934	8,792	431	32.6	365	33.3	18	8.9	8,081,820	923	390,860	44.63	4.84
1935	8,908	686	42.1	857	44.8	153	10.5	9,365,966	1,028	408,315	45.03	4.36

ity is a combination gas and electric company.

Strictly from the utility standpoint, the cost of adding load to the line has been cut to a minimum by the present method of operation. Based on the first ten months of 1935 it cost the company $9.30 to add an electric range and $7.90 to add an electric refrigerator. The unit cost per range is low, because such wiring as is required is capitalized, wiring allowances beng granted on 52 per cent of the ranges sold in 1935. These costs, however, include bonuses, advertising, radio, administration and overhead, clerical expense, store and window rental and all other costs of operation which might conceivably be attributed to range and refrigerator load building (see Table II). Also of interest is the annual average income per domestic customer of $45.03. Furthermore, public relations have never been better on the Sierra Pacific's system. A municipal ownership mayoralty candidate recently was defeated overwhelmingly because the whole electrical industry in northern Nevada is back of the utility which has helped it prosper. In addition, had the utility been merchandising ranges and refrigerators it would have had upward of $500,000 on the books on three-year terms. Today it has less than $5,000 of 30-day accounts. No collection losses and improved public relations due to the elimination of installment buying from the company are desirable benefits of this policy.

Details of the co-operative program

Behind the merchandising program is the philosophy that an intensive coverage of the company's 9,000 domestic customers is necessary to build load successfully. Because the territory is sparsely settled, this coverage is not possible with any other method except that of having active dealers located throughout the territory.

Table II—Cost to Utility of Range and Refrigerator Sales

	Range	Refrigerator
Bonuses	$3.30	$2.00
Advertising	2.30	2.65
Radio	.08	.19
Cooking schools	1.00	.55
Salaries and administration	.98	1.22
Clerical expense	.07	.07
Floor and window rental	.93	.88
Janitor and light	.30	.34
Bookkeeping and miscellaneous	.34	....
Total	$9.30	$7.90

Table III—Per Cent of Major Appliance Sales by Types of Retail Outlets

	Per Cent	
	Range	Refrigerators
14 Electric dealers	92.9	71.8
3 Hardware	1.7	4.1
2 Chain	0.0	11.2
1 Furniture	0.0	0.9
2 General merchandise	4.6	6.3
3 Miscellaneous	0.8	5.7
	100.0	100.0

Therefore, the company has aimed at making electrical merchandising profitable for a larger number of retail outlets. Today the utility's commercial department is strictly a service organization, generating ideas and suggestions, handling complaints, public relations, doing strictly promotional work, such as the Better Light-Better Sight activity and selling nothing but the company's services. The department consists of only six people in addition to Mr. Lemmon. One is charged among other responsibilities with contacting the 26 dealers. There is a home economist who conducts the cooking schools in addition to contacting all new cooking customers. One man specializes on lighting promotion, both domestic and commercial. A customer contact man handles high bill complaints and other matters concerning public relations. There is a serviceman, part of whose salary should be charged to the operating department. The sixth man is a clerk who serves as assistant service man at Lake Tahoe during the summer resort season.

Four distinct contributions are extended to all co-operating dealers. These are (1) a kilowatt and/or unit bonus on electric ranges, water heaters, refrigerators and space heaters; (2) a wiring allowance for electric ranges replacing competitive fuels (coal, wood, oil and butane) in old residences; (3) advertising co-operation, and (4) cooking schools and home demonstration helps.

Bonuses are paid directly to the dealers monthly when sales are made to domestic residential consumers in which electric appliances displace competitive fuels, are installed in new homes or increase the connected load already existing. Domestic residential consumers are defined as customers living in single-family dwellings or in duplexes in which the owner occupies one unit. The schedule of payments follow:

1. Fifty cents per kilowatt for each kilowatt of electric range or cooking device having at least 3 kw. of capacity and wired on a three-wire, 115-230-volt system. (No bonus is paid when the electric appliance sold displaced a similar manufactured gas appliance.)

2. One dollar per kilowatt for each kilowatt of capacity of an electric water heater, with the same restriction as in 1.

3. Two dollars for each refrigerator.

4. One dollar per kilowatt for each kilowatt of electric space heaters having at least 2 kw. of capacity and/or wired for 230 volts.

A wiring allowance of $35 is paid to the dealer selling or the contractor installing an electric range having a capacity of at least 6 kw. which dis-

[*Continued on page 86*]

D.C. Transmission in France

Operating Data on the 275-Mile D.C. Line Between Moutiers and Lyon Briefly Reviewed and Summarized

What's the story on this d.c. transmission line over in France that comes up for discussion every so often when engineers get together? Nobody seems to know very much about it here in the United States, and still there is a certain degree of curiosity about it. And so, for the record, "Electrical World" offers a compact summary of what the line is, what it does and how it works, through the co-operation of O. K. Marti of the Allis-Chalmers Manufacturing Company.

THERE is a d.c. line over in France in regular, day-by-day operation transmitting up to 20,000 kw. at a d.c. voltage of 125,000 volts over a distance of 275 miles between the cities of Moutiers, up in the Tarentaise Alps, and Lyon (population 539,581), in the valley of the Rhone. Forty-five miles of the line runs in cable and the remaining 230 miles is overhead construction.

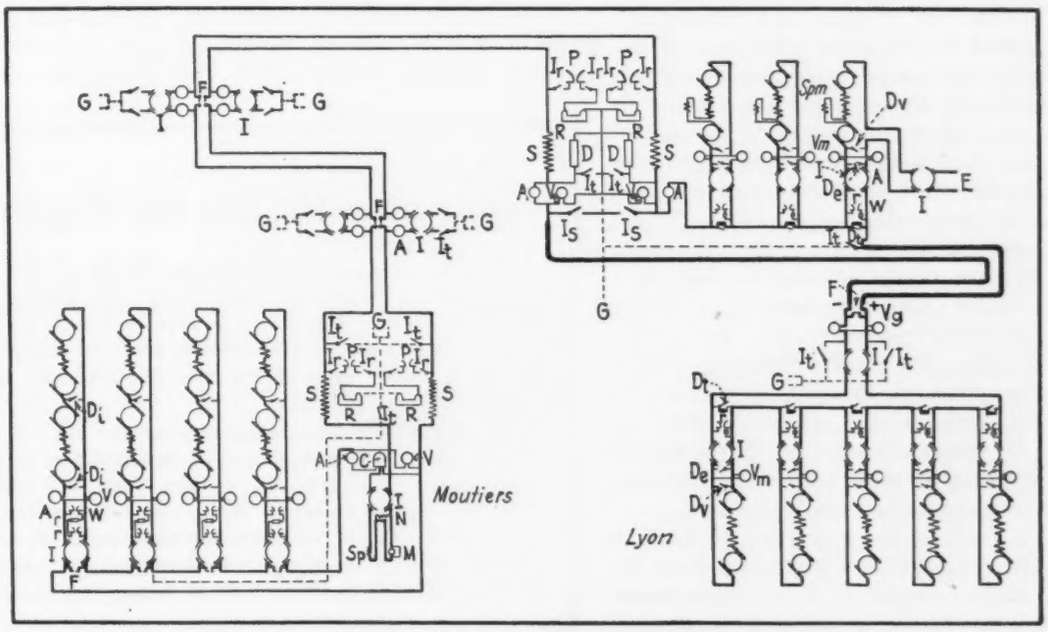
There isn't space here to go into the history of the line. Suffice it to say, perhaps, that the line is 30 years old and the original voltage was some 55,000. Originally there were two copper conductors, 124,000 circ.mil each, supported on wooden poles most of the distance. The cable portion of the line consisted of two cables, 148,000 circ.mil each, made up of nineteen conductors with paper insulation, all in a double-lead sheath, and an iron tape with tarred linen for added protection.

Overhead line ohmic resistance was 98 ohms, 2 ohms for the cable, or a total of 100 ohms. Two additional conductors have since been installed and the total current has been raised to 150 amp. Thus the voltage drop has remained the same, and line losses of 1,125 kw. are about 6 per cent of total power now generated.

A schematic diagram of connections of the entire system as originally installed is shown in the accompanying illustration. The power plants at Roziere and Vignotan, added subsequently, are not shown in this diagram. Power is generated near Moutiers by four groups of four generators each, all connected in series. The 230-mile overhead line passes through sectionalizing stations (there are now four) and enters the receiving station on the outskirts of Lyon, where some of the power is taken from the line by three sets of motors, also connected in series. These, in turn, drive three sets of three-phase generators. Here is where the cable installation originally began, extending to the end of the line in downtown Lyon. At this point five sets of motors, all in series, convert the rest of the d.c. power into mechanical power, which drives five d.c. generators for supplying the Lyon street railways.

Power can be fed into the system at numerous points and apparently the system is quite flexible. For example, the three-phase generators in the first-mentioned receiving station can be used to feed the local three-phase network or can be operated as motors to drive the d.c. motors as generators, or

I Closed-circuit sector switch.
I_r Disconnecting switch for lightning arresters.
I_t Disconnecting switch for ground wire.
I_s Sectionalizing switch.
G Ground.
D Discharge resistor.
P Lightning arrester for transmission line.
r Lightning arrester for generators or motors.
R Water resistor.
W Non-inductive resistor.
S Reactors.
E Exciter, also used as starter.
D_i Switch for reducing voltage of one machine group to zero.
D_g Device for speed reduction.
D_i Device for preventing reversal of direction of rotation.
D_e Automatic arcing contactor.
F Safety device.
V_m Voltmeter for machines.
V_l Voltmeter for line to ground.
V Main voltmeter.
C Kw.-hr. meter (Kva.-hr. meter).
A Ammeter.
N Shunt resistor for regulation.
M Regulating motor.
S_p Regulating coil for generator.
S_{pm} Regulating coil for motor.



Schematic diagram of the original Moutiers-Lyon d.c. system

to assist the generating station at Moutiers, or to serve as a standby.

Operating details

Originally at Moutiers four sets of generators were installed, each set consisting of two double generators, or a total of sixteen generators. Each generator delivered 3,600 volts at 300 r.p.m., making a total of 14,200 volts approximately per set, the whole set delivering 1,150 kw., or a total for the entire power plant of 4,600 kw. Later two other small plants were added, raising the voltage of the system to 100,000. Three sets of generators are installed at Roziere, each for 18,000 volts and 150 amp., or 2,700 kw. per turbine. The voltage on each commutator in this plant is 4,500.

The first motors to be installed were rated at 530 kw. per set of two machines and operated at 428 r.p.m.

For putting the system into operation one or more groups of generators are inserted into the closed circuit formed by the line.

The generators of one group are put into the circuit by means of the closed circuit sector switch I. This breaker is, to begin with, in position to short circuit the generator. If the group of generators being started is one regulated by speed variations the turbine is started slowly, until the generator delivers a short-circuit current equal to the line current, or 150 amp. To deliver this current the machine runs at very slow speed, of course. The closed circuit sector switch is then moved to open the short circuit and simultaneously the machine is placed on the line. Voltage and current generated remain exactly the same as before; the prime mover has to furnish only the losses in the generator. To put load on the generator the voltage is raised gradually by increasing the speed. The automatic current regulator keeps the current constant by decreasing the speed of the other generators in the station, so that their voltage also decreases by a corresponding amount.

After the newly started generator has attained the proper voltage the regulator of the set is connected to the common station regulator and the current of the whole station is kept constant automatically.

To take the generator off the line its regulator is disconnected from the station regulator, the turbine slowed down and the generator short circuited and disconnected from the line. Short circuiting of the generator should be done at the instant that its output voltage is equal to zero. This cannot be determined with sufficient accuracy from the volt-meter, and it is therefore necessary to shut the turbine down entirely and operate the closed circuit sector switch (see illustration) at the moment that the machine stops. However, before this is done, the entire line current flows through the generator and produces a torque which tends to operate the generator in the reverse direction.

In order to prevent this an automatic switch is tripped by a ratchet-and-pawl arrangement mounted on the end of the generator shaft, which operates just at the moment that reversal of direction takes place, short circuiting the machine and closing the line circuit.

Ground return operation

For some time the Moutiers-Lyon transmission system was successfully operated with the ground as one conductor, without any difficulties.

Moreover, the entire electric light, power, and traction requirements of the city of Lausanne, Switzerland, were supplied for a period of one year over a single-conductor, ground-return d.c. system. A total of 150 amp. at 27,000 volts, or about 4,000 kw., was transmitted in this way for a distance of some 35 miles through congested urban territory without any difficulties whatsoever. In fact, it is said the lightning arresters did not operate once, even during the height of the thunderstorm season.

Total resistance of the grounds averaged 1.76 ohms and the ground connections gave no trouble of any kind.

Any ground or partial ground on the line, short circuit on the loop, lightning disturbance, etc., results either in the momentary appearance of sparks on the commutators of the machines or, in the case of a severe disturbance (such as a direct short circuit, ground or lightning stroke), flashovers of all the commutators then in operation. In such a case the commutators themselves act as surge arresters and protect the armature windings against breakdown. These flashovers have been reduced to a large extent, however, by the installation of iron-wire reactors and condensers at the points where the line enters the power plants.

At present the power stations are protected by large iron core reactors and Ledoux coils. In addition, the armatures of machines are shunted by non-inductive resistances. Potential distribution on each group is effected by balancing resistors made of occelite rods. The passage of potential surges is assured by spark gaps, with occelite resistors connected across the terminals of the machines.

Since this is a constant-current, variable-voltage system, the amount of power generated or consumed can readily be measured by using a meter the number of revolutions of which are proportional to the voltage. The meters actually employed consist of a fixed magnet and an armature, which is connected in series with a very high resistance, the meter and resistance being connected between the two incoming terminals of the receiving station. The number of revolutions of this meter is therefore proportional to the power received. These meters are, of course, insulated for the full line voltage.

Governor Pleads for Highway Lighting

Very few communities spend over $1.50 per capita for public illumination—and our economic waste from night motor accidents runs around $12 per capita. When you realize that one public hospital in Detroit reported an outlay of $300,000 in 1931 for night emergency *motor cases* alone, it ought to be clear that the taxpayer pays for street lighting whether he gets it or not.

At the present time we are laying out upward of three billion dollars a year for the extension and maintenance of public highways, and, depression or no depression, we now boast of 110,000 miles of improved highways in this country. When you consider that only about 400 miles are lighted—most of them poorly—it hardly seems unreasonable to suggest that we spend a few millions less on roads and more on lights.—GOV. HAROLD G. HOFFMAN of New Jersey in *Liberty*.

New Meter Assembly Catches Transformer Loads

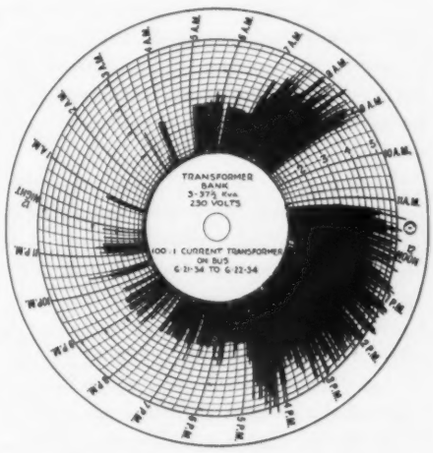
Electrothermal Demand Ammeter With Current Transformer Functions on All Ratings of Distribution Transformers

Accurate determination of safe loads for transformers is an important factor in economical design of distribution systems. Maximum oil temperature is a guide to safe load, but it does not show electrical load independent of ambient temperature. The maximum shown from year to year will vary according to the temperature conditions at the time of the maximum, thus making load comparisons almost impossible between different years. For these reasons the Commonwealth Edison Company has made it a practice to measure transformer loads either with a maximum demand ammeter or a recording ammeter, and from this practice the measuring device described was developed.

By C. F. MITCHELL
Service Investigation Engineer, Commonwealth Edison Company, Chicago

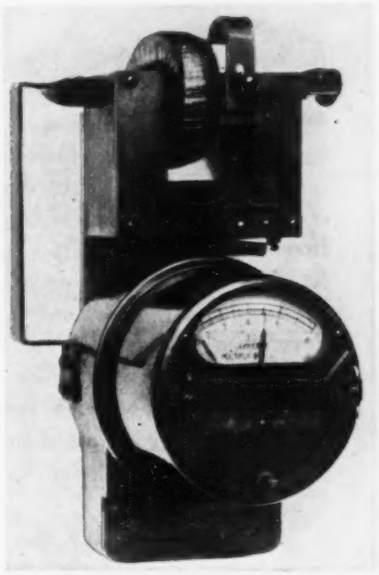
FOR measuring distribution transformer loads the instrument used most extensively by the Commonwealth Edison Company has been the Wright acid type maximum demand ammeter. The only disadvantage of the meter is that unequal heating or radiation from the case affects the accuracy. It was connected to the transformer by means of leads to a dummy plug in the primary neutral cutout. This arrangement was convenient, the meter being at practically ground potential and a jumper prevented load interruptions while connection was being made. On transformers of 25 kva. and larger the use of a different type of cutout prevented the use of this meter. On the larger sizes, as well as on the small sizes having a solid neutral, it was necessary to use a split-core current transformer and recording ammeter. This also had disadvantages, because on rapidly fluctuating load, such as elevators, it was impossible to estimate the effective load on the transformer. The accompanying chart illustrates this fact, although the meter in this case had the greatest possible amount of damping. The reading of a Lincoln thermal ammeter for the same period on the same transformer was 180 amp.

In addition to the disadvantage of the above types of metering equipment, the policy of eliminating all neutral cutouts in favor of a solid connection made it imperative that a new meter arrangement be devised. It was important that it be inexpensive, so that a considerable number could be kept in service, also that it be convenient to handle, light in weight, weatherproof, well-compensated for all temperatures, and capable of being installed in any position. It was also desirable to have a meter which could be used on any common size of transformer.



Recording ammeter record unsatisfactory

When transformer load is widely variable it is practically impossible to determine the mean load from a recording ammeter chart.



Meter-transformer assembly

The end piece of the rectangular core is pulled open by the spring when the latch at the top is raised.

The Lincoln electrothermal type maximum demand ammeter was found to meet most of the requirements. The case, while designed for indoor use, was made weatherproof by the substitution of a rubber for the felt-cover gasket. It is not sensitive to level and will indicate accurately in any position except face up. In order to make the meter adaptable to any size of transformer, a split-core current transformer was designed and attached to it. The ratios 20:1 and 60:1 were selected as most suitable for operation with a meter having a full scale reading 6 amp. The 20:1 ratio is used when transformers up to 25 kva. are tested on the secondary; the 60:1 ratio is used on sizes up to 75 kva., and for 100 kva. and larger the 20:1 ratio is used with the current transformer on

[*Continued on page 89*]

Sinking Fund Best for Hydro Depreciation

Long Life, Small Early Replacement Requirements, Infrequent Increments to Capital Establish Inappropriateness of Straight-Line Method of Depreciation Accounting

In a previous article **(ELECTRICAL WORLD,** ***March 14, 1936*****)** ***the author condensed an extensive study of the life history of U. S. hydro stations and showed that in the case of a large modern hydro development (1) risk of obsolescence is slight, (2) a conservative estimate of the composite life of depreciable property is at or near 50 years, (3) retirements and charges to depreciation reserve are small for many years, and (4) a large accumulated depreciation reserve cannot be invested in plant because extensions are rare and capital additions negligible to fully developed modern hydro. Here it is shown that this leads to the inevitable conclusion that straight-line depreciation is totally unsuited to such power developments and, in principle, proportionately unsuited to the needs of consumer and investor in other long-life systems.***

By R. L. THOMAS

General Superintendent Pennsylvania Water & Power Company

A MODERN hydro-electric development may be said to be of a "static" character. Life expectancy is uncertain, but is known to be relatively long. Cash requirements for renewals and replacements are very small for a long period of years and annual addition to capital are normally small. Hence the bulk of a hydro-electric generating company's annual depreciation allowances charged to operating expense must be invested in securities or held as cash.

Under these conditions the straight-line method of depreciation is inequitable and discriminatory; the sinking fund method is equitable and non-discriminatory. The straight-line method imposes unduly heavy operating charges in the early development period; builds up the depreciation reserve too rapidly, and may lead to endless controversy over the difference between depreciation for expense accounting and depreciation for valuation and rate making. In conjunction with the use of a depreciated rate base, the straight-line method results in fluctuating and predominantly diminishing rate base and net income. The ratepayers in the early years are penalized or discriminated against for the benefit of the ratepayers in later years.

Under the sinking fund method the annual depreciation charge to operating expense is less and the reserve builds up more slowly. The method, in conjunction with an undepreciated rate base, results in uniform rate base and net income, except as additions to property or changes in valuation are made. There is no discrimination as between ratepayers in early and later years.

In the case of long-lived or semi-permanent structures and equipment, such as those under consideration, it is obviously impossible to estimate salvage value and it is assumed for convenience that such value is exactly offset or canceled by the cost of removal. Hence under the straight-line method the annual depreciation allowance to be charged to operating expense and credited to depreciation reserve is determined by dividing the cost of each type of property by the estimated life.

Under the sinking fund method the annual depreciation allowance charged to operating expense is so fixed that these yearly installments or annuities plus interest accumulations will at the expiration of the estimated service life equal the cost. The annual gross credit or addition to the depreciation reserve thus consists of (1) the annuity which is charged to operating expense and (2) compound interest applied to the reserve or fund at the established rate, which is not chargeable to operating expense for rate-making purposes.

Two methods contrasted

It is important to understand the relation of each method to the rate base. When the straight-line method is used, under what may be called the conventional method of rate making, the accrued depreciation is deducted from cost or value in determining the rate base. On the other hand, when the sinking fund method of depreciation accounting has been followed by the utility no deduction for accrued depreciation is made in determining the rate base. This has been the actual practice when the utility has followed the sinking fund method, as previously described, in its depreciation accounting, and the Interstate Commerce Commission (177 I.C.C. 410), the Wisconsin Commission's depreciation pamphlet (pages 25, 78, 85-91), and all writers on the subject agree that when this method is followed an undepreciated rate base should be used. Crudely stated, the distinction is somewhat as follows:

> Under the straight-line method the utility is entitled to, or has the free use of, whatever earnings are received on the depreciation reserve accumulated from the ratepayers' contributions, whether the reserve is represented by plant, securities or cash. Under the sinking fund method, however,

the interest on the depreciation reserve, or on the depreciation fund if there is a segregated asset fund, is added to the reserve. Thus the investors receive no return on the reserve, and therefore should receive from the ratepayers a return on the full undepreciated rate base.

A comparative analysis of the straight-line and sinking fund methods as applied to a project with the characteristics previously discussed supports the conclusions already stated.

Rate of accumulation of reserve

The straight-line method builds up the depreciation reserve much too rapidly and long in advance of requirements for retirements. The rapid accumulation of a huge reserve may not be so objectionable in the case of the ordinary electric utility with a distribution system which requires considerable additions to fixed capital even in "bad" times, thus furnishing a use for the funds represented by the depreciation reserve, but in the case of a hydro-electric company we have seen that major capital additions are infrequent. Fig. 1 compares the straight-line and sinking fund methods for an assumed hypothetical property.

"Straight line" virtually "dead storage"

Of course in "real life" all property is not retired at the exact time estimated. Assuming that the average life is known, some units will be retired earlier and some later than the average. When there is a large number of similar units of property, rigorous mathematical analysis shows that ultimately the curve of depreciation reserve (expressed in per cent of depreciable property) against years under the straight-line method would flatten out and become constant at a value somewhat under 50 per cent of the depreciable property cost. Under the sinking fund method the per cent reserve would also ultimately become constant, but at a very much lower value. Under the straight-line method the ultimate reserve may then be likened to the "dead" storage in the bottom of a reservoir, in that it can never be used for its nominal purpose; *i.e.*, retirements. The same thing may be said to some extent of the ultimate reserve under the sinking fund method, but in this method it is recognized that the reserve serves the purpose of supplying earnings, which, added to the annuities paid by the ratepayers, will take care of retirements.

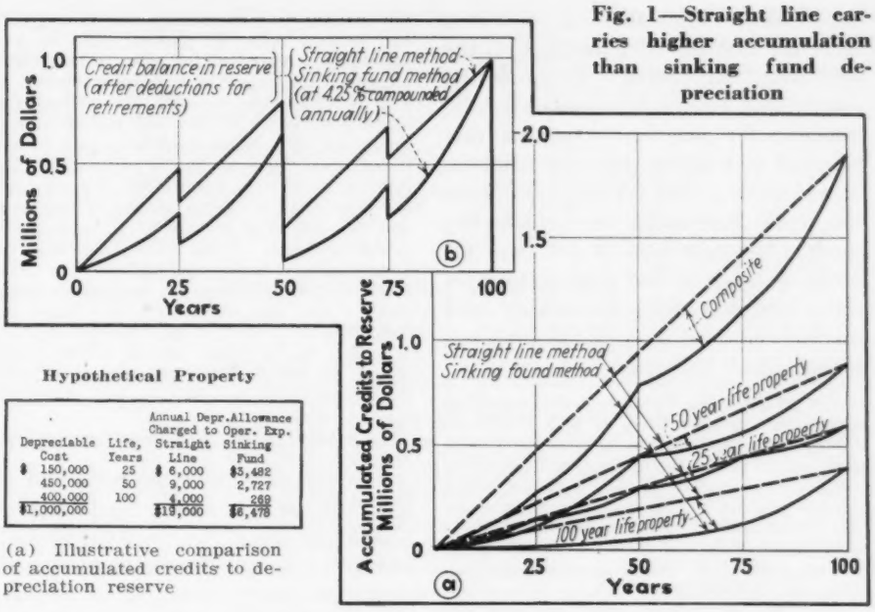


Fig. 1—Straight line carries higher accumulation than sinking fund depreciation

Hypothetical Property

Depreciable Cost	Life, Years	Annual Depr. Allowance Charged to Oper. Exp. Straight Line	Sinking Fund
$ 150,000	25	$ 6,000	$3,482
450,000	50	9,000	2,727
400,000	100	4,000	269
$1,000,000		$19,000	$6,478

(a) Illustrative comparison of accumulated credits to depreciation reserve

No deductions from accumulated credits for retirements. Sinking fund computed at 4¼ per cent interest compounded annually. Under sinking fund method the annual amount credited to reserve is the sum of the allowance charged to operating expense and the interest accrual.

(b) Illustrative comparison of credit balance in depreciation reserve after deductions for retirements. Depreciable property lives as in (a). Annual allowance for depreciation and interest rate also as in (a).

Recognizing the fact that the accumulation of such a relatively great reserve as under the straight-line method is undesirable, state commissions have sometimes limited the size of the depreciation reserve.

It is believed that the reserve as built up under the sinking fund method (Fig. 1) approaches the curve of true accrued depreciation much more nearly than under the straight-line method. Although it is not possible to determine true depreciation with accuracy, it is believed that it occurs gradually. It is probably slight during the early years of life and increases with lapse of time. Under the sinking fund method the question is relatively unimportant, since the rate base is undepreciated and it is not necessary to know the amount of accrued depreciation at any particular time for rate-making purposes.

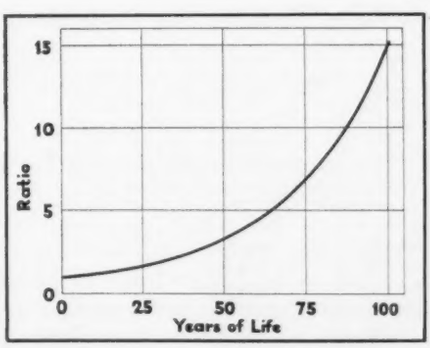


Fig. 2—Ratio of annual depreciation allowance under straight-line and sinking fund methods

Sinking fund interest at 4¼ per cent compounded annually. Annual allowance under sinking fund method is the amount charged to operating expense, exclusive of interest accrual.

For long-life property the straight-line method naturally results in a much greater annual allowance, relatively speaking, than the sinking fund method. Referring to the tabulation in Fig. 1(a), in which the sinking fund method is computed at 4¼ per cent compounded annually, note that the ratio of the allowance under the straight-line method to that under the sinking fund method is 1.7 for the 25-year component, 3.3 for 50 years, 14.9 for 100 years and 2.9 for the composite property. The ratios are plotted in Fig. 2 for lives from one to 100 years.

Effect on stockholders and ratepayers

If the larger allowance under the straight-line method is made fully operative immediately, and if it cannot be passed on to ratepayers during the early development period, as is sometimes the case, the net return is correspondingly reduced and a heavy and unjust burden is imposed on the stockholders. This statement does not need elaboration, as the condition is temporary and the effect is obvious.

In the orthodox case, of which a detailed analysis has been made, the

depreciation allowance is collected from the ratepayers in addition to the allowable fair return. To make the comparison as simple as possible, it is assumed for rate base purposes that original cost rather than reproduction cost is used, or that the two are always the same; that under the straight-line method the rate base is cost less the credit balance in the depreciation reserve, and that under the sinking fund method the rate base is the undepreciated cost. Example:

For purposes of illustration the simplified numerical example used in Fig. 1 will be carried on. It is assumed that the depreciable cost of $1,000,000 remains fixed, without any additions; that the utility earns 4¼ per cent on the depreciation reserve under either method by investment in bonds or other securities, and that the operating expenses other than depreciation remain constant at $100,000 per year.

The rate base, the annual operating revenue or ratepayers' contribution necessary to give a 7 per cent rate of return, and also the annual balance available to the utility for interest, dividends and surplus under the two methods are plotted in Fig. 3. The figures for certain key years are also shown in the accompanying table. Note that under the sinking fund method the rate base, the ratepayers' total annual payment and the utility's annual balance for interest and dividends remain constant. There is no discrimination as between either the ratepayers or the stockholders in the early years and in the later years. The utility's balance for interest and dividends also remains constant.

Under the straight-line method the rate base diminishes as the depreciation reserve increases, and in fact in our hypothetical case the rate base disappears altogether in the one-hundredth year, just before complete renewal of all property is made. Annual adjustments in rates would theoretically be required. The ratepayers in the earlier years are discriminated against in favor of those in the late years. The amount paid by the ratepayers is greater in the first eleven years than the amount paid under the sinking-fund method in the same years and greater than the amount paid in any subsequent year under the straight-line method. Referring to the lower curves of Fig. 3 under the straight-line method the balance available for interest and dividends fluctuates, in general diminishes, and in our hypothetical case is finally reduced to the interest earned on investments representing the depreciation reserve, since the rate base and the operating revenue have reached the vanishing point. These investments must be conservatively made and in part at least must be in liquid form. A frequent assumption is that the utility will buy back its own bonds. The interest earned will be less than the allowed rate of return. The utility is penalized to the extent of this difference (2.75 per cent in our example).

No justification for discrimination

The comparison in the table and in Fig. 3 is the crux of the whole matter. The hypothetical case is exaggerated, but it correctly illustrates the principles involved. Assuming, as we may, that the adequacy and quality of service rendered by the utility are uniform, there is no justification for the discrimination with respect to both ratepayers and stockholders or for the fluctuations and general reduction in the stockholders' earnings under the straight-line method. Overlooking the discrimination against the ratepayers in the early years, the aggregate payment by the ratepayers to the utility over the whole period will be less under the straight-line method than under the sinking fund method, but this reduction is effected by disregarding equity to the utility as a consideration. The utility should not be penalized because of the impossibility of earning the full rate of return on a reserve which is very much larger than is wanted or needed. Putting it another way, the ratepayers should not be required or permitted to anticipate depreciation and reimburse the utility for capital investment, and thus in effect retire investment for rate-making purposes, long before the physical property is actually retired, when the utility cannot productively use the funds thus paid back to it.

If uniformly fair treatment of both ratepayers and stockholders is the objective, as it should be, the sinking fund method rather than the straight-line method will be used under the assumed conditions.

Sinking fund method is not new and untried

The sinking fund method was the first, and for a long time the only, method of providing against depreciation. References to its use by industries date back to 1800. The straight-line method is comparatively new and seems to have originated with the telephone companies, which have been its consistent advocates. Obviously their problem is very different from that of a hydro-generating company.

The sinking fund method has been used in California since the statute of 1911 in effect prescribed that method; in Oregon since 1916, and to some extent in several other states. It has not been used extensively by electric utilities in the East. These utilities in general have followed the so-called retirement reserve method rather than either the straight-line or the sinking fund method. Furthermore, until the last

Comparative Results Under Sinking Fund Method and Conventional Method of Applying the Straight-Line Method for Hypothetical Case

Year	Deprec'n. Reserve Beginning of Year S.L.M.	Rate Base at Beginning of Year		Operating Revenue or Total Payment by Ratepayers		Non-Op'g. Revenue	Available for Interest and Dividends	
		S.L.M.	S.F.M.	S.L.M. $119,000 + .07B	S.F.M.	S.L.M. 0.0425A	S.L.M. D — $119,000 + F	S.F.M.
	A	B	C	D	E	F	G	H
1	0	$1,000,000	$1,000,000	$189,000	$176,500	0	$70,000	$70,000
5	$76,000	924,000	1,000,000	183,700	176,500	$3,200	67,900	70,000
10	171,000	829,000	1,000,000	177,000	176,500	7,300	65,300	70,000
11	190,000	810,000	1,000,000	175,700	176,500	8,100	64,800	70,000
25	456,000	544,000	1,000,000	157,100	176,500	19,400	57,500	70,000
26	325,000	675,000	1,000,000	166,300	176,500	13,800	61,100	70,000
50	781,000	219,000	1,000,000	134,300	176,500	33,200	48,500	70,000
51	200,000	800,000	1,000,000	175,000	176,500	8,500	64,500	70,000
75	656,000	344,000	1,000,000	143,100	176,500	27,900	52,000	70,000
76	525,000	475,000	1,000,000	152,300	176,500	22,300	55,600	70,000
100	981,000	19,000	1,000,000	120,300	176,500	41,700	43,000	70,000

NOTE: Figures are rounded out to the nearest $100. Rate of return assumed as 7 per cent. Rate of earnings on reserve assumed as 4.25 per cent.

few years the industry has been constantly expanding and growing, and the utilities, particularly as nearly all of them own distribution systems, have been able to invest the depreciation reserve in plant. Also it is admittedly difficult for a long-established company which has followed one method to change to another method, but this fact should not act to prevent a new company or project from following the best method for its own particular case.

The fact that the Interstate Commerce Commission, after an exhaustive study, prescribed the straight-line method in the case of telephone and railroad companies (cases 14,700 and 15,100, 118 I.C.C. and 177 I.C.C.) has undoubtedly had much influence on those who advocate the straight-line method for all utilities. However, it must be remembered that in these cases the telephone companies were the ardent advocates of the straight-line method and that the railroad companies argued for the retirement reserve method. There was no advocate of the sinking fund method before the commission and it is rather surprising that the commission gave the sinking fund method as much attention in its reports as it did. Furthermore, telephone and railroad properties are very different in many respects from a modern hydro-electric property.

Sinking fund method not unduly complicated

An objection to the sinking fund method which is sometimes heard is that it is complicated. Even if this were true, mere simplification of accounting is not sufficient reason for imposing a method which is undesirable and unfair. The whole matter of depreciation accounting, particularly using any age-life method, necessarily involves some complications, but the regulatory authorities do not for that reason eliminate such accounting.

Perhaps the computation of the annual allowance under the sinking fund method is slightly more complicated than under the straight-line method, but all that is involved is the elementary use of compound interest tables. Other alleged complications are largely avoidable or are based on the delusion that mathematical accuracy is possible in any case. Doing away with an asset depreciation fund removes some of the accounting complications. The fixing of a definite and somewhat arbitrary interest rate, in line with the practice of the Oregon and California commissions, based on particular conditions, removes the complications of uncertain and fluctuating interest rates, which seemed to be the chief objection to the sinking fund method cited by the I. C. C. (177 I.C.C., 412 to 413).

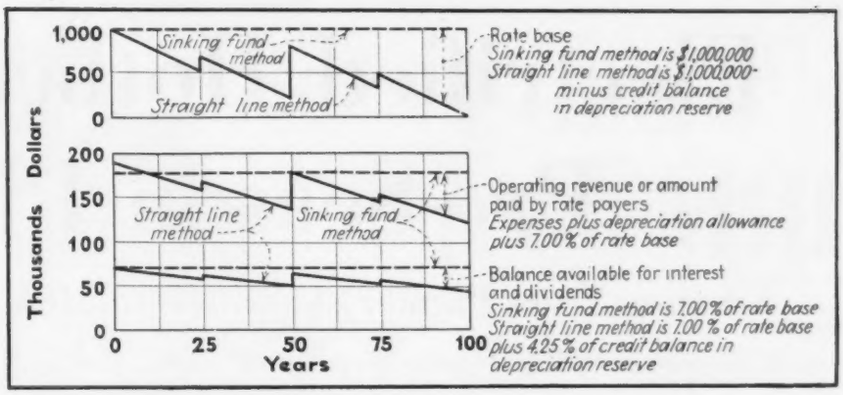


Fig. 3—Comparison of earnings under two methods

For the sinking fund method the rate base is the undepreciated plant investment.
For the conventional commission application of the straight-line method the rate base is the plant investment minus the credit balance in the depreciation reserve.
Assumed rate of return 7 per cent. Depreciation reserve assumed to be invested in securities earning 4¼ per cent.
Cost of depreciable property, lives, annual allowances for depreciation and interest compounding as in Fig. 1. Annual operation, maintenance, taxes and general expenses taken at $100,000 on $1,000,000 undepreciated plant investment.

An admitted minor disadvantage of the sinking fund method is the fact pointed out by various writers that the effect of deviations from the estimated life is accentuated under the sinking fund method and that an excess life of a certain number of years of one item in a group does not offset a shortage of life of the same number of years in another identical cost item in the same group. From this it has been argued that a complicated mathematical study of dispersion of retirements is required. The latter might be true, in spite of the fact that the maximum error is only a few per cent, in the case of a property consisting of a multitude of identical items concerning which adequate experience or actuarial data are available. However, it cannot be repeated too often that in the case of a hydro project there are no such data, and the lives cannot be estimated with any degree of accuracy. The estimates are simply the best guesses that can be made for obtaining a reasonable over-all allowance. Therefore mathematical refinement cannot be justified. The logical and simple method of protecting against the above-mentioned mathematical characteristic of the sinking fund method is to play a little safe in estimating the lives. For this reason there is valid reason for being more conservative in estimating lives under the sinking fund method than under the straight-line method.

Any minor complications in accounting under the sinking fund method are far more than offset by over-all simplification of the determination of rate base and rate of return. The use of an undepreciated rate base eliminates the endless controversy that has arisen in rate cases over the amount of accrued depreciation to be deducted in determining the rate base. The Wisconsin pamphlet cites as one of the advantages of the sinking fund method that "it can be used to avoid a finding of accrued depreciation for rate-making purposes" (page 26). The use of an undepreciated rate base also of course automatically eliminates the necessity for distinguishing between depreciation for the purpose of expense accounting and depreciation for the purpose of rate making.

In conclusion, it is believed that this analysis shows that the compulsory use of the straight-line method of depreciation accounting by all electric utilities would be unwise and unfair, and that in the case of hydro-generating companies in general the sinking fund method is more suitable and equitable than the straight-line method. However, the author does not believe that the sinking fund method should be prescribed, even for all hydro companies. Special historical, physical and economic conditions must be considered. It seems highly desirable that the regulatory authorities provide flexibility in their regulations and exercise discrimination in depreciation accounting methods.

Electrified Hotbeds Yield Pre-Season Plants

Arkansas Truck Farmer Electrifies Tenth-of-an-Acre Hotbeds to Compete With Early Season Produce From Rio Grande Valley

AN ELECTRIFIED hotbed system with a capacity of approximately 1,000,000 plants and in which nearly 8,000 ft. of soil-heating cable, totaling about 50 kw., is involved has been completed on the truck farm of Charles J. Gault, near Magnolia, Ark., under the direction of Hardee Kilgore and Willis R. Greer, engineers of the Arkansas Power & Light Company.

Representing a total investment of $3,000, this project involves about $1,500 in electrical equipment and labor and is planned to produce tomato plants, sweet potato slips, cabbage plants and similar crop plants to compete with early season produce from the Rio Grande Valley.

Eight individual beds, each 7½x75 ft., comprise the hotbed system. Each bed is divided into three 25-ft. sections by 4-in. concrete walls. The beds run east and west, with the north wall 2½ ft. higher than the front wall. Two separate sheets of canvas, supported on rafters, cover the beds.

Soil in each bed is heated independently in three sections by thermostatically controlled soil-heating cable.

Each section is provided with two lengths of heating cable 125 ft. long and one length 63 ft. long. This cable is run back and forth from north to south across the beds at intervals of 7 in. The 125-ft. lengths are connected through a thermostat to 230 volts, while the 63-ft. section is connected to 115 volts. Capacity of the heating cable in each section is approximately 1,900 watts, representing a heat release of about 6,500 B.t.u. per hour per section. Two beds of the eight are equipped with four 150-watt lamps per section to provide heat above the ground. These lamps are painted black to prevent light from affecting plant growth.

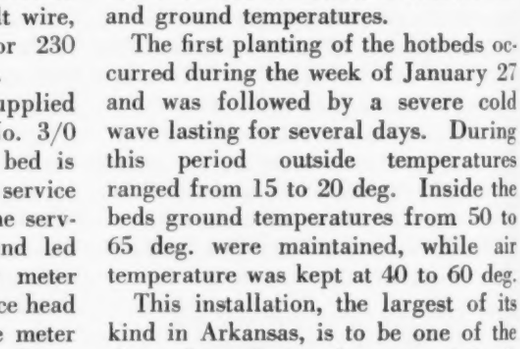
Energy is supplied through four No. 8 weatherproof wires run along the entire length of the north wall of the beds, stretched between insulators attached to uprights bolted to the wall. The top wire is the grounded neutral, the middle two wires carry 230 volts between them. The bottom, or control wire, which is separate for each 25-ft. section, is connected through the section thermostat to one of the 230-volt wires. Heating cable is connected between the thermostat and the grounded neutral or the opposite 230-volt wire, depending on whether 115 or 230 volts is desired across the cable.

Power for the hotbeds is supplied from the transformer by a No. 3/0 service. At the end of each bed is located a pole on which the service wires are strung that supply the service. The wires are tapped and led down to a standard outdoor meter set-up, going through an entrance head and conduit into a socket type meter and to a fuse safety switch. From the switch the lines are run in conduit underground to the beds. Each bed has its own service, meter and switch. The entire service is operated through a kw.-hr. and maximum demand meter.

Data on all functions of the beds with regard to planting, consumption of energy and temperature are carefully recorded. One recording thermometer and two recording voltmeters are in use. Indicating thermometers are placed in each bed, in the ground as well as in the air. Thermometers are also used to ascertain outside air and ground temperatures.

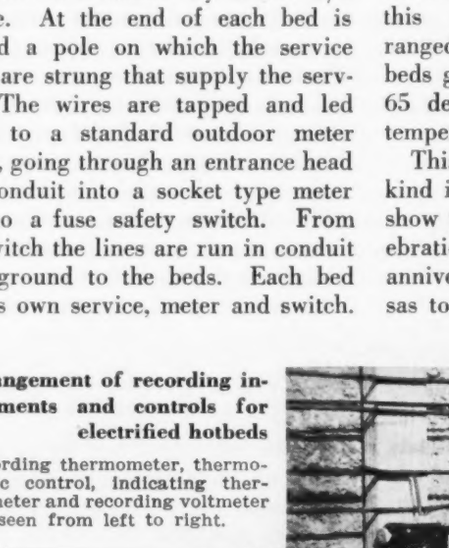
The first planting of the hotbeds occurred during the week of January 27 and was followed by a severe cold wave lasting for several days. During this period outside temperatures ranged from 15 to 20 deg. Inside the beds ground temperatures from 50 to 65 deg. were maintained, while air temperature was kept at 40 to 60 deg.

This installation, the largest of its kind in Arkansas, is to be one of the show places during the centennial celebration in observance of the 100th anniversary of the admission of Arkansas to the Union.



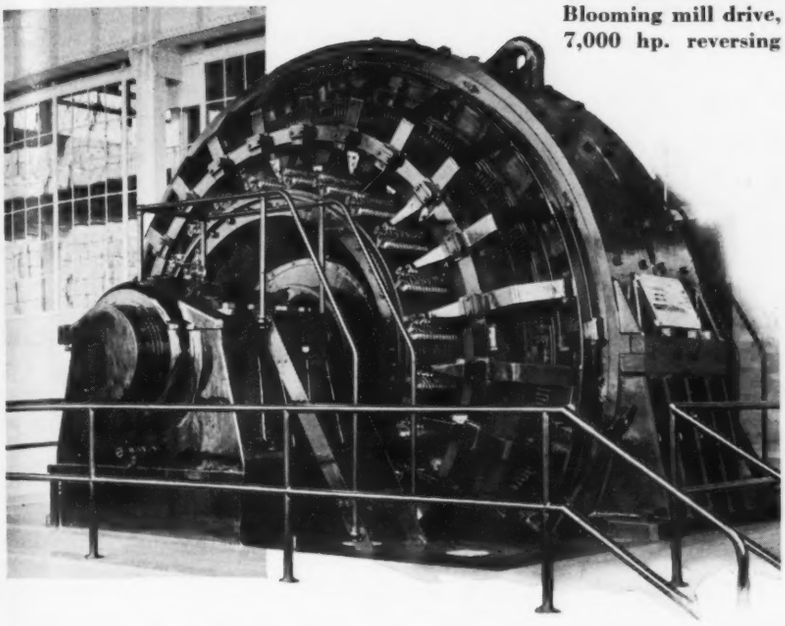
Arrangement of recording instruments and controls for electrified hotbeds

Recording thermometer, thermostatic control, indicating thermometer and recording voltmeter are seen from left to right.



Electric soil-heating cable as installed in hotbeds

Cable is laid on a base that consists of 12 in. of cinders covered with about 2 in. of sand. Over the heating cable is a 6-in. layer of specially prepared soil in which the seeds are sown.



Blooming mill drive, 7,000 hp. reversing

Ford's Steel Mill

Automobile Production Demands More and More Sheet Steel—And More and More Electricity Enters Into Its Production

By FRANK R. INNES
Western Editor

AMONG the modern things that have been pushed almost to an ultimate development in the new blooming and strip mills at the River Rouge plant of the Ford Motor Company are unit type inclosed switchgear, complete metal-clad channel bus construction, use of nonmetallic sheath cable, across-the-line starting of very large motors and generous application of Selsyn motor indicators, limit switches, magnetic brakes and other control devices.

There are three mills in the Ford program, a 44-in. blooming mill, a 56-in. hot strip mill and a final cold strip mill. Included in the program is a large provision for annealing and normalizing by electric heat, making use of 30 bell-type furnaces and a new development in continuous strip annealing. But these heat applications make another story, to be told another day. When the new installation, mills, heat treating furnaces and associated equipment, is in full production it will turn out sufficient steel sheet to keep 3,000 cars rolling off the end of the assembly line every working day.

This article is primarily concerned with the electrical end of the installation, but for proper understanding of it a description of this aspect must be prefaced by a general statement of what is comprised in the rolling mills.

The 44-in. blooming mill, which takes the billets from the soaking pits and reduces them to slabs, consists of a single reversing stand driven by a 7,000-hp., 50/120-r.p.m., 750-volt d.c. motor followed by a slab crop shear. The delivery direction of this mill is south (see location diagram). Parallel and to the west is the head end of the 56-in. hot strip mill, with two oil-fired reheating furnaces lying between. The slabs may be transferred straight across from the bloomer to enter the strip mill or they may be held on a storage table and then passed through the reheating furnaces. The hot strip mill is comprised of a scale breaker, three edgers, four roughing mills and six finishing stands. The roughing stands are double roll and the finishers are four-roll units. The main drives of the hot strip mill in order from the head end are:

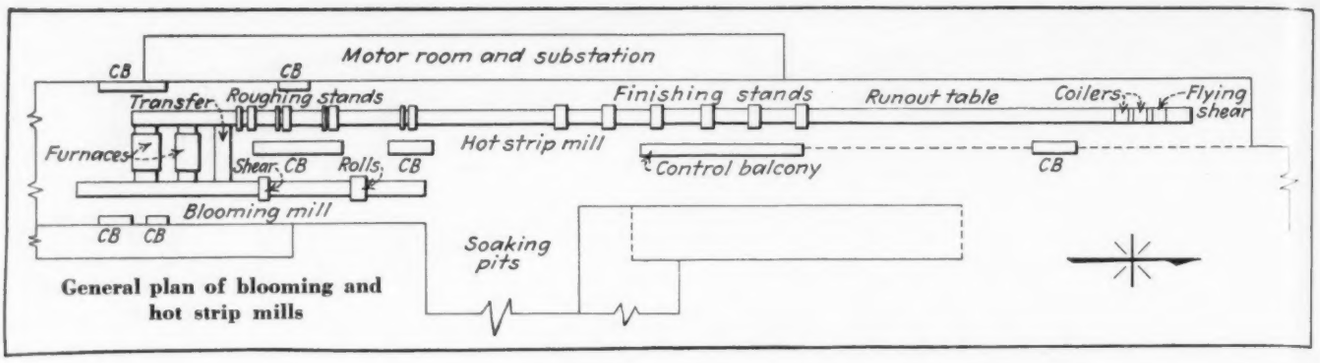
Mill	Hp.	R.P.M.	Volts	Type
R-1, Scale breaker..	800	590	440	S.R.*
R-2, Roughing.....	2,500	593	13,200	S.R.
E-1, Edger.....	600	400/800	230	D.c.
R-3, Roughing.....	2,500	514	13,200	Syn.†
E-2, Edger.....	600	400/800	230	D.c.
R-4, Roughing.....	2,500	514	13,200	Syn.
E-3, Edger.....	150	400/800	230	D.c.
R-5, Roughing.....	2,500	514	13,200	Syn.
F-1, Finishing.....	400	300/600	550	D.c.
F-2, Finishing.....	3,000	200/400	550	D.c.
F-3, Finishing.....	3,000	200/400	550	D.c.
F-4, Finishing.....	3,000	200/400	550	D.c
F-5, Finishing.....	2,500	150/300	550	D.c.

*S.R. = Slip ring. †Syn. = Synchronous.

Between the last roughing mill and the first finishing stand is a new thing in the strip rolling art. It is an air-cooled roll table. For 97 ft. along the west edge of the table runs a 10-in. header pipe. Welded into this at 1-ft. intervals and extending across above the table are 2-in. pipes with perforations opening downward along their lengths and capped at the far ends. Jets of high-pressure air thus play on the strip as it moves along on the roll table.

Loopers for taking up slack between stands are installed between finishing mills F-2 and F-3, F-3 and F-4 and F-4 and F-5. The looper motors are served by a small low-voltage motor-generator set driven by induction motor and the control is so arranged that after the looper mechanism has moved to the proper position the

New devices, new layouts and new ideas are being applied to the electrical features of industrial plants these days. Industry is going to electrical ways of doing things far more rapidly than it is increasing its volume of production. Each type of industry is a specialized application in its engineering and sales approach. But many of the new ideas and equipments developed for one industry can be applied to others. Engineers and power salesmen will gain much information on modern industrial plant electrification by reading about this new steel mill of the Ford Motor Company. It shows a modern electrical installation. It gives ideas to apply to other types of industrial plants.



General plan of blooming and hot strip mills

motor is stalled and sufficient torque is exerted to hold the looper tightly against the strip. The looper motor is automatically controlled from a relay connected across the series fields of the motor driving the preceding stand ahead of where the looper is located. After the strip reaches the preceding stand and the driving motor is unloaded the looper motor is reversed and the looper mechanism is returned to its initial position. The looper motors are also controlled at will by the operators.

All roll tables up to the last finishing stand are of the gear and shaft type with 50-hp. motors driving the sections. The run-out table at the end of the mill has individual drive rolls, 130 of them, each equipped with ½- to 1-hp. induction motors with speed control from 320 to 640 r.p.m. accomplished by frequency variation. About 150 ft. from the last finishing stand the run-out table contains two strip coilers, one after the other, so that one can be coiling while the other is being unloaded. One table roll just ahead of each coiler is insulated and may be energized at 32 volts. When the head end of the strip comes along and makes contact with this roll the particular coiler starts to operate. If desired the strip may run over both coilers and be cut into lengths by the flying shear at the end of the run-out table. The flying shear equipment is designed to shear the strip into approximately 15-ft. lengths when the mill is operating anywhere from 800 to 1,600 ft. per minute. The electrical equipment consists of a 50-hp. motor, 400/800 r.p.m., 250 volts, and this motor drives a gear train used to adjust the length of cut. Shifting of the gears in the gear train allows adjustment of the length of cut. The shear head is driven by a 100-hp., 500/1,200-r.p.m., 250-volt, mill type d.c. motor. Photo-electric cells or flag switches are used to start and stop the shear head motor automatically. This allows control of the crop end of the strip.

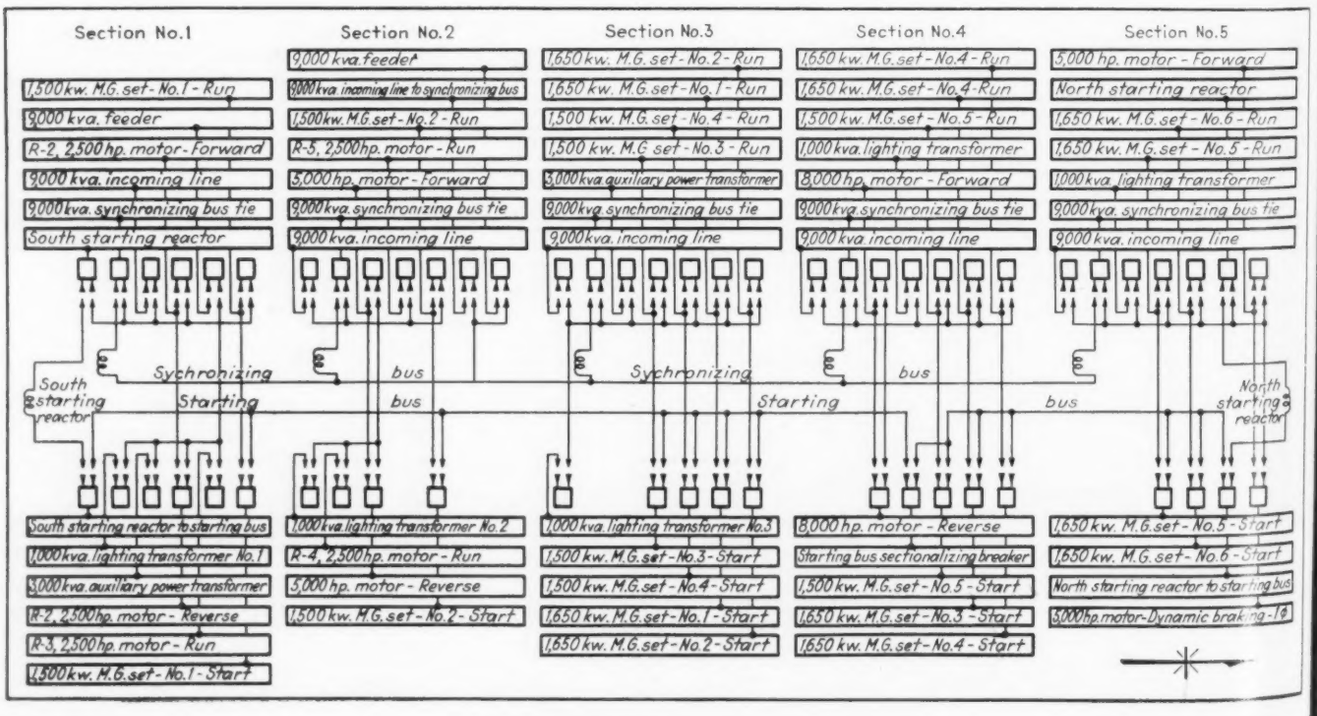
The present cold finishing mill installation consists of one three-stand tandem mill, one reversing mill and two tempering mills. These mills were quite far from completion at the time the material for this article was secured and hardly more information can be given here than that their main drives will total about 1,000 hp.

Power supplied over five lines

Power is supplied to the new mills by five 9,000-kva., 13.2-kv. lines. Another line is looped into the substation and tied to the synchronizing bus, but it does not normally carry any part of the mill load. Through reactors each of the five lines enters a section of metal-clad switchgear structure in the

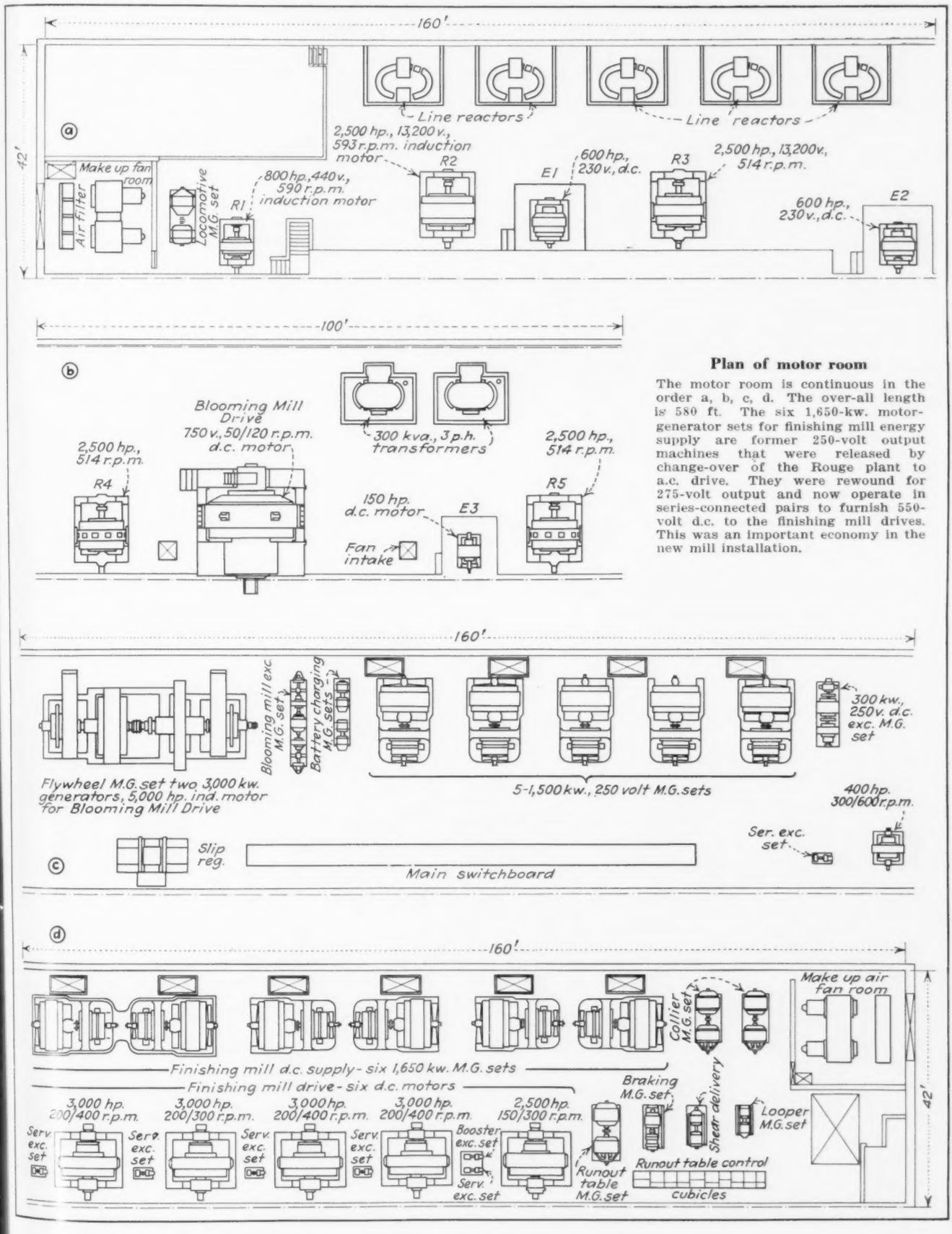
Scheme of 13.2-kv. switching

Most of the breaker designations can be identified with equipment shown in the motor room plan, but some cannot thus be tagged. Among these are the 5,000-hp. motor in section (b) of the motor room and the 8,000-hp. motor in section (d). These motors are in other mills and their energy supply was modernized by inclusion in the new construction.


Section No.1
1,500 kw. M.G. set - No.1 - Run
9,000 kva. feeder
R-2, 2,500 hp. motor - Forward
9,000 kva. incoming line
9,000 kva. synchronizing bus tie
South starting reactor
Section No.2
9,000 kva. feeder
8000 kva. incoming line to synchronizing bus
1,500 kw. M.G. set - No.2 - Run
R-5, 2,500 hp. motor - Run
5,000 hp. motor - Forward
9,000 kva. synchronizing bus tie
9,000 kva. incoming line
Section No.3
1,650 kw. M.G. set - No.2 - Run
1,650 kw. M.G. set - No.1 - Run
1,500 kw. M.G. set - No.4 - Run
1,500 kw. M.G. set - No.3 - Run
3,000 kva. auxiliary power transformer
9,000 kva. synchronizing bus tie
9,000 kva. incoming line
Section No.4
1,650 kw. M.G. set - No.4 - Run
1,650 kw. M.G. set - No.4 - Run
1,500 kw. M.G. set - No.5 - Run
1,000 kva. lighting transformer
8,000 hp. motor - Forward
9,000 kva. synchronizing bus tie
9,000 kva. incoming line
Section No.5
5,000 hp. motor - Forward
North starting reactor
1,650 kw. M.G. set - No.6 - Run
1,650 kw. M.G. set - No.5 - Run
1,000 kva. lighting transformer
9,000 kva. synchronizing bus tie
9,000 kva. incoming line
Synchronizing bus
Starting bus
South starting reactor
North starting reactor
South starting reactor to starting bus
1,000 kva. lighting transformer No.1
3,000 kva. auxiliary power transformer
R-2, 2,500 hp. motor - Reverse
R-3, 2,500 hp. motor - Run
1,500 kw. M.G. set - No.1 - Start
1,000 kva. lighting transformer No.2
R-4, 2,500 hp. motor - Run
5,000 hp. motor - Reverse
1,500 kw. M.G. set - No.2 - Start
1,000 kva. lighting transformer No.3
1,500 kw. M.G. set - No.3 - Start
1,500 kw. M.G. set - No.4 - Start
1,650 kw. M.G. set - No.1 - Start
1,650 kw. M.G. set - No.2 - Start
8,000 hp. motor - Reverse
Starting bus sectionalizing breaker
1,500 kw. M.G. set - No.5 - Start
1,650 kw. M.G. set - No.3 - Start
1,650 kw. M.G. set - No.4 - Start
1,650 kw. M.G. set - No.5 - Start
1,650 kw. M.G. set - No.6 - Start
North starting reactor to starting bus
5,000 hp. motor - Dynamic braking - 1¢

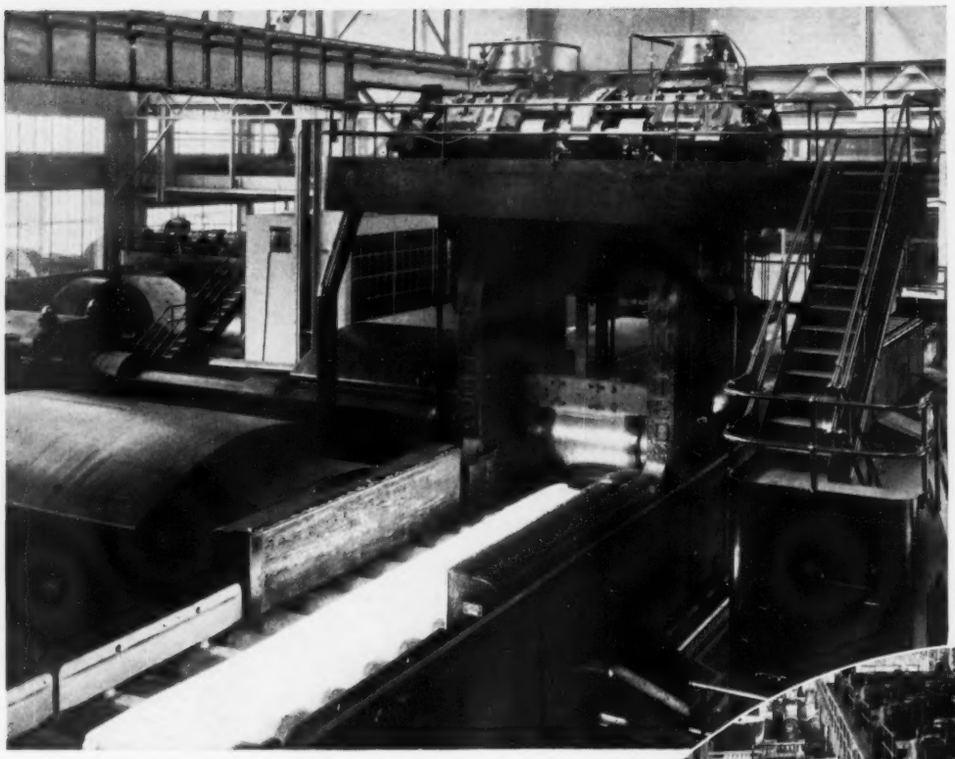
basement of the combination substation and mill motor room. The scheme of this vertical-lift oil circuit breaker structure appears in an accompanying one-line diagram. Except for connections to synchronizing and starting buses, the five sections of the switch structure are separate. The starting bus is used only for the drives of the 1,500- and 1,650-kw. motor-generator sets; the other 13.2-kv. synchronous and induction motors, including the 5,000-hp. induction motor on the flywheel set for the blooming mill drive, are started across the line.

The flywheel motor-generator set for the 7,000-hp. blooming mill motor consists of two 3,000-kw., 360-r.p.m.,

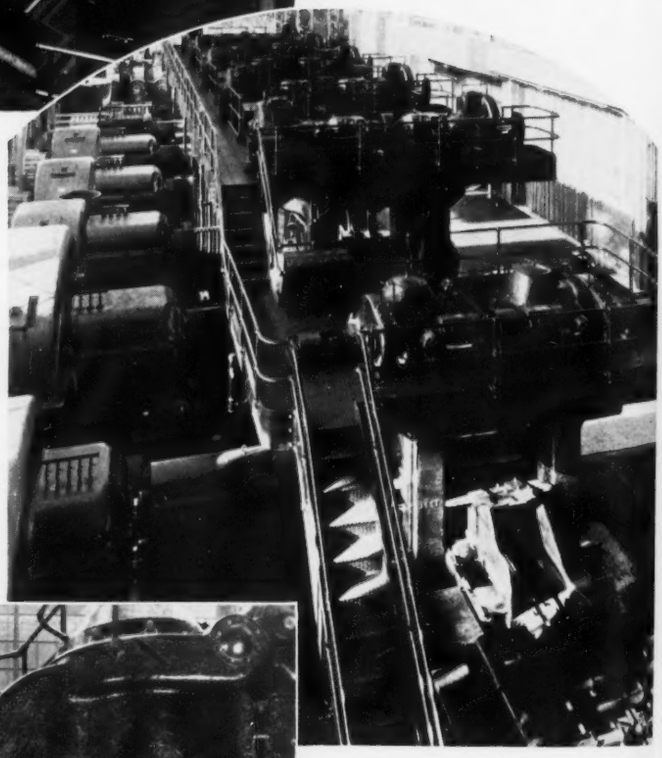


Plan of motor room

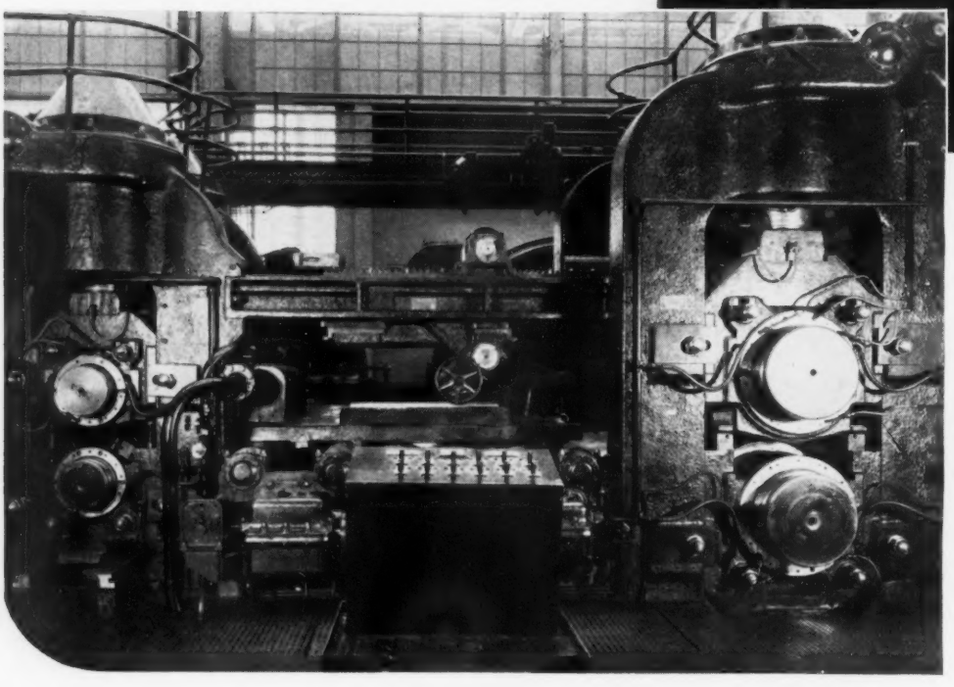
The motor room is continuous in the order a, b, c, d. The over-all length is 580 ft. The six 1,650-kw. motor-generator sets for finishing mill energy supply are former 250-volt output machines that were released by change-over of the Rouge plant to a.c. drive. They were rewound for 275-volt output and now operate in series-connected pairs to furnish 550-volt d.c. to the finishing mill drives. This was an important economy in the new mill installation.



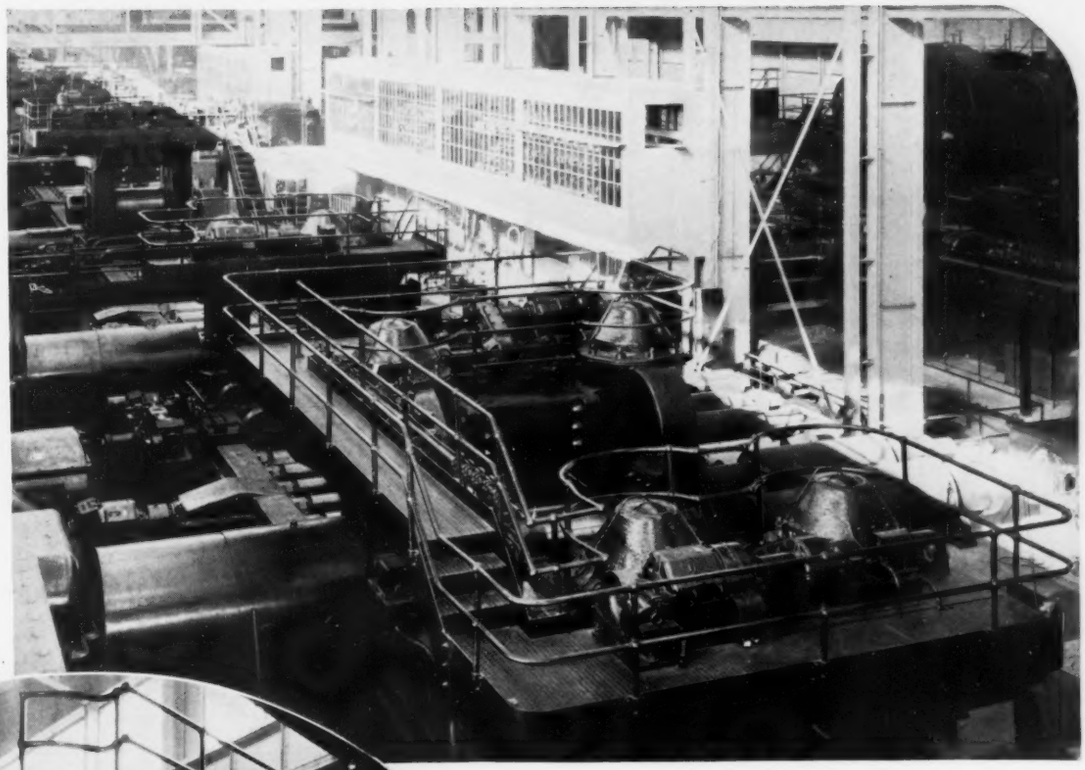
BLOOMING MILL—On the top are three separate functional applications of electricity. The top roll of the mill is screwed up and down by a pair of 150-hp. motors. Solenoid electric brakes stop these motors with the mill rolls exactly set. Selsyn motors indicate roll positions to the mill operator.



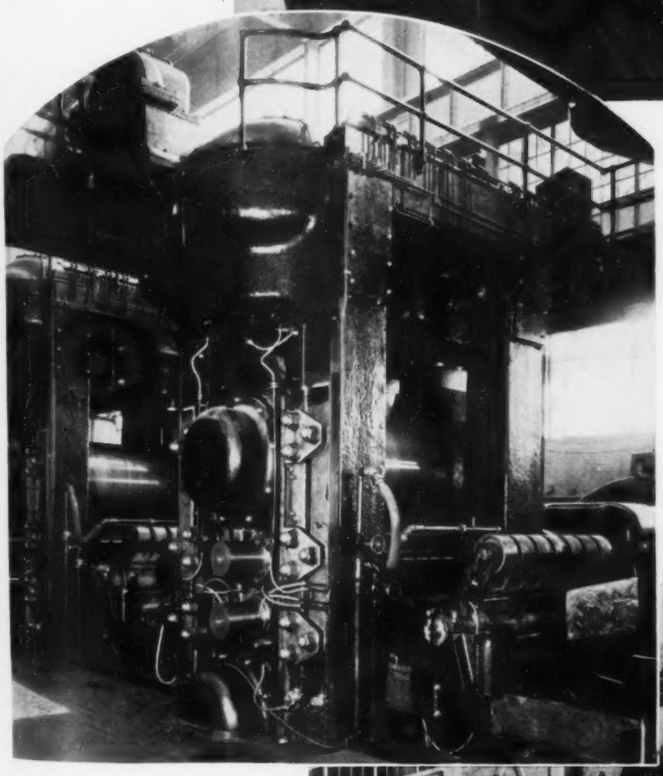
FINISHING STANDS—Along the left are the reduction gears between the rolls and the 3,000-hp. drive motors. At the right along the wall are the control balconies.



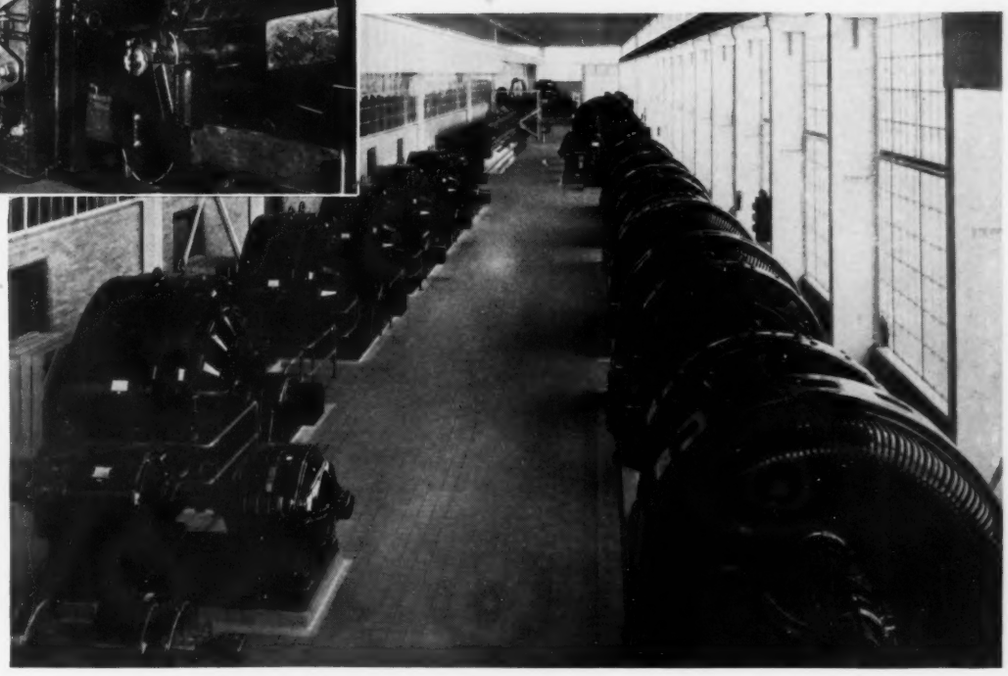
FIRST ROUGHING STANDS — At the left is the scale breaker, driven by an 800-hp., 440-volt slip-ring motor. The second rougher, at the right, is driven by a 2,500-hp., 13.2-kv. synchronous motor started across the line.



TOP VIEW ROUGHING STANDS—Note screw-down drives shown clearly in right foreground, complete with solenoid brake and Selsyn position indicator.

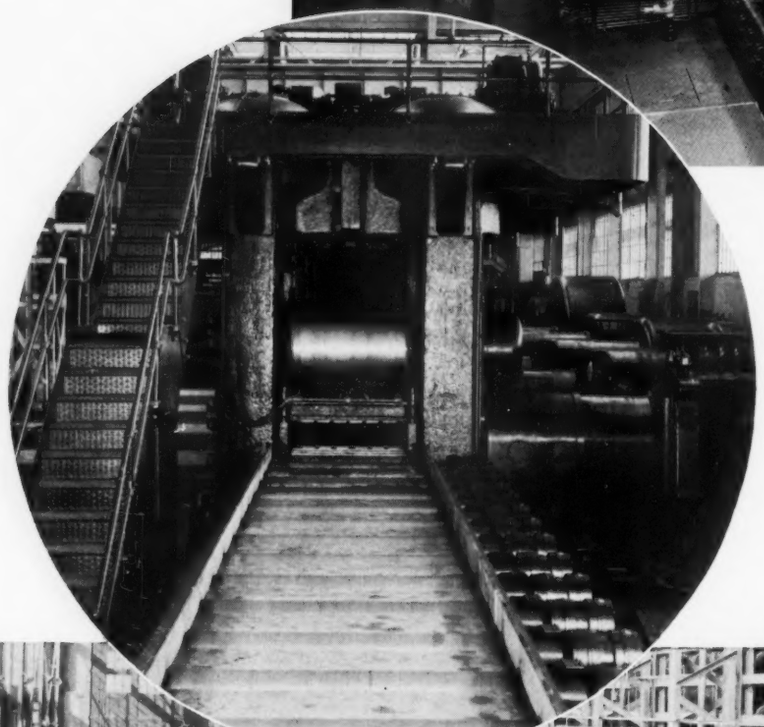


LOOPERS TAKE UP THE SLACK—Getting thinner, the steel strip elongates as it passes through the rolls and the roll speed of the stand next ahead must always be greater than that of any given stand. This speed difference is provided for in the control of the roll drives, but the control can never be accurate enough to prevent entirely the accumulation of slack in the strip between roll stands. To keep the strip taut, "loopers" are provided. These devices are simply a line of idler rolls mounted on a transverse shaft and held by a torque motor tightly against the running strip.

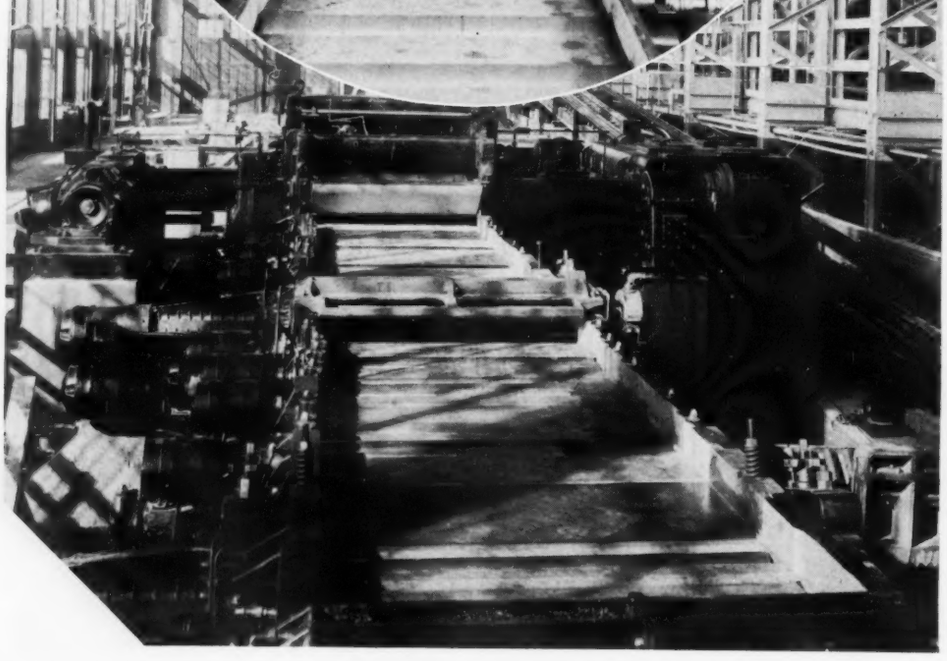


MOTOR ROOM—At the left are the 3,000-hp. finishing mill drives. The motor-generator sets are along the right wall. First come the six 275-volt machines, operating in three series-connected pairs to supply 550-volt energy to the finishing mill motors.

SECOND EDGER AND FOURTH ROUGHING STAND—In left foreground is electrical equipment for vertical roll screw mechanism, square beam in background is enclosure of blooming mill drive shaft.



HEAD OF RUN-OUT TABLE—In the center is the last stand of the finishing mill. Each roll of the run-out table is powered by an individual induction motor. Energy supply for these motors is from a variable frequency-changer set by means of which the speed of the rolls is controlled.



COILERS AND FLYING SHEAR—These devices are a maze of electrical drives and controls. Note the motors cloistered like grapes at the left.

750-volt generators operating in parallel and an 80-ton flywheel driven by the 5,000-hp. slip-ring induction motor as stated above. Rotor current in this motor is controlled by a liquid slip regulator. The magnitude of transient currents due to rolling peaks in the conductors between this motor-generator set and the motor it supplies requires an exceptionally strong conductor structure. The conductors consist of a double bus, two negative and two positive, inclosed in a continuous housing of sheet aluminum. Construction of these metal-clad buses is shown in accompanying illustrations. A feature of the structure is the means provided to care for expansion and contraction of the aluminum bus channels, which in places are about 100 ft. long. The channels rest on rollers set into the bottoms of the bus clamps and flat bronze springs bear on the tops of the channels with approximately 40 lb. pressure. This device, while holding the conductor securely in place, allows for movement due to temperature changes. At several points where the bus changes direction expansion joints are provided as well.

Metal-clad bus structures designed for varying duties are used throughout the substation and also in the mill for supplying 230-volt d.c. to contactor solenoids for motor controls. Leads to motors and other equipment are all of rubber-insulated, shielded braid-covered cable, no lead-covered conductors being used anywhere.

Because of the severe conditions to which conductors are subjected in steel mill installations it has been quite generally the practice to make much larger use of lead-covered conductors than is ordinary in the average run of industrial wiring. But the use of such cable is costly, not only in first expenditure, but also when revisions of wiring arrangements, not an uncommon necessity in a steel mill, are made.

For these reasons the availability of recently developed non-metallic cables capable of resisting the adverse conditions of steel mill wiring has been treated with considerable enthusiasm in this special field. Also, new ideas in the application of rigid bar conductors adequately housed in steel inclosures have reduced the number of places where lead-covered cable has heretofore had the only consideration. Thus the absence of lead cable in the Ford steel mill installation constitutes a striking recognition of the progress that has been made in the construction of insulated cable designed to withstand severe installed conditions and of the advances in practice in the use of rigid, mechanically protected conductors.

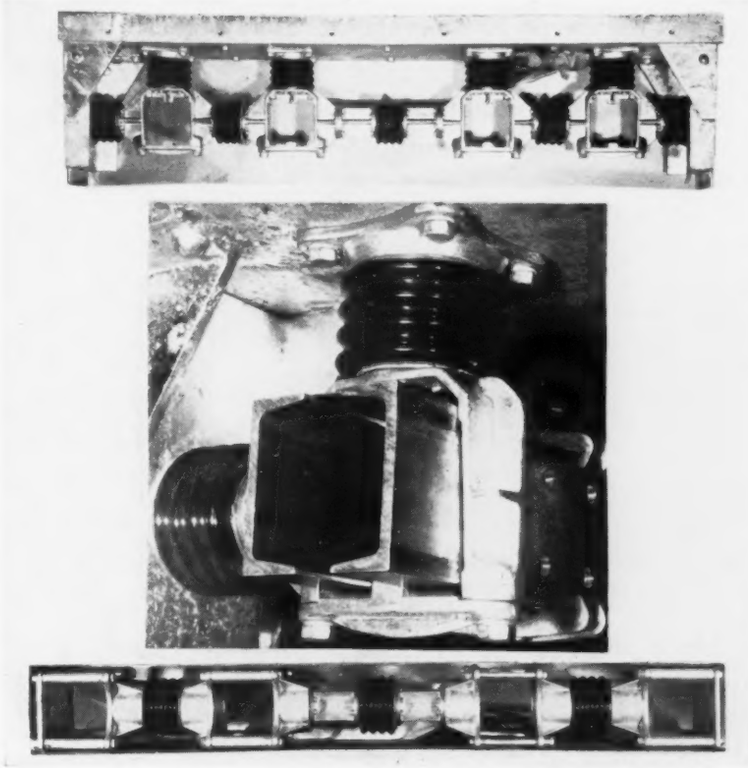
For a number of years the Ford engineers have been carrying out a program of changeover from d.c. to a.c. drive in the Rouge plant. This has released a number of motor-generator sets. The new steel mill opened up a use for some of these machines. Instead of buying new units to supply d.c. to the finishing mill drives it was decided to revamp six of these old machines for this use. Their compound windings were changed to shunt and their output voltages raised from 250 to 275. Their ratings were thus increased from 1,500 to 1,650 kw. The motor ends were amply able to carry the increased load. Pairs of the generator ends were connected in series, to result in three 3,300 kw., 550-volt outputs, 9,900 kw.—more than sufficient to serve five motors totaling 11,900 hp.

Selsyns much used

One of the most striking things about the new mills is the ubiquitousness of Selsyn motors. Everywhere they meet the eye. They show the operators in the control balconies the exact positions of roll screwdowns. They indicate the travel of gage stops and the angular movements of torque-motor drives. They perform a lot of other signaling and position reporting functions. This use of Selsyns in steel mill work is rather new and it demonstrates the many different purposes to which these useful devices can be put in industrial applications. Use of electric brakes and limit switches is no new thing in steel mills. But probably no comparable mill ever used so many of these devices in so many different places. In practically every one of the accompanying illustrations where a motor is visible there can be seen also an electric brake and probably a limit switch as well.

In a recently published interview Henry Ford is quoted as foreseeing

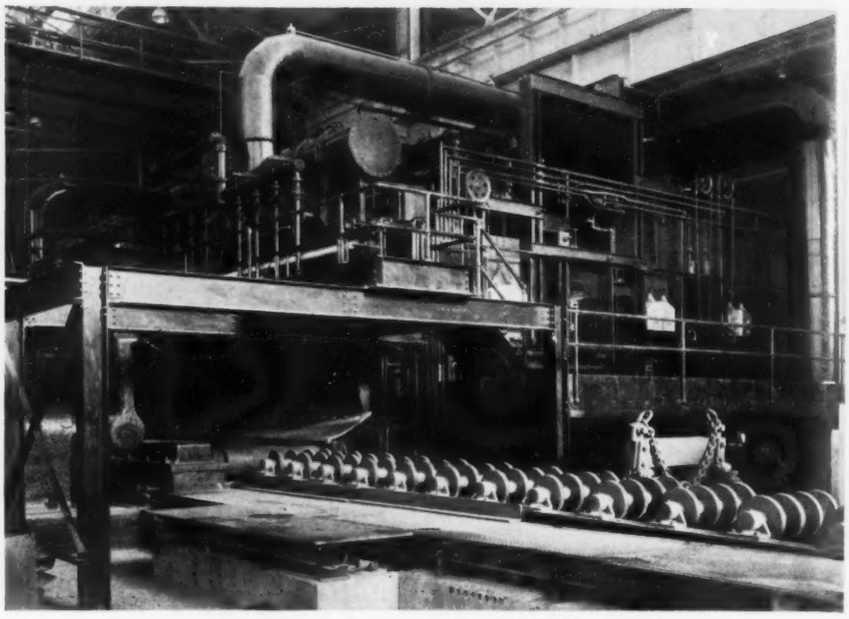
SUPER-STRONG BUS CONSTRUCTION



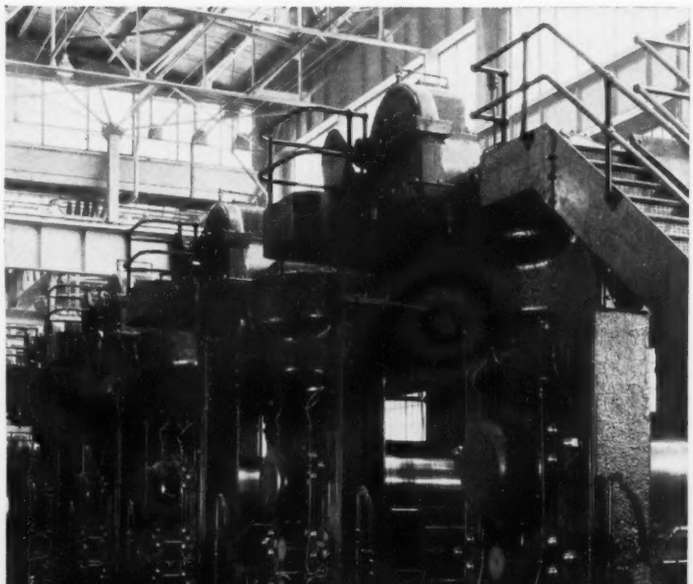
Conductor bus to the 7,000-hp. blooming mill motor is inclosed in sheet aluminum housing. The bus consists of eight aluminum channels with 5-in. web and weighing 3.11 lb. per foot. The four negative and four positive channels are assembled in pairs, flange to flange and spaced to approximate a 5-in. square in section. The four assemblies thus formed are carried in a horizontal row with the pair on one side positive and on the other negative. The top detail shows the bus supports bolted together and at top and ends to the galvanized steel-supporting frame. The supports are spaced on about 5-in. centers and midway between them are spacer structures as shown in the lower detail. In addition to being held by the bus supports and spacers, the aluminum channels in each pair are reinforced every few inches with heavy clamps, as appears in the background of the larger detail above.

these great new mills rendered obsolete by some new method, as yet unknown, for producing steel sheet. Whatever that method may be, there is little danger of going wrong in the confident prediction that electricity will play a major part in it. With that assured, there will be an article on it in ELECTRICAL WORLD.

The mills were designed, furnished and erected by the United Engineering & Foundry Company. Suppliers of equipment and materials included Allis-Chalmers Manufacturing Company, main drives; General Electric Company, main drives and control and indicating equipment; Westinghouse Electric & Manufacturing Company, main drives, 13.2-kv. metal-clad switching equipment; Reliance Electric & Engineering Company, run-out table and coiler motors; Electric Controller & Manufacturing Company, limit switches, magnetic brakes and general control equipment; Delta-Star Electric Company, heavy-current bus structures; Cutler-Hammer, Inc., general control equipment; Crocker-Wheeler Electric Manufacturing Company, auxiliary drives; I.T.E. Circuit Breaker Company, air-circuit breakers; Square D Company, distribution cabinets and general control equipment; Electric Storage Battery Company, control battery; Esterline Angus Company, graphic instruments; Electric Products Company, battery-charging generator; Electric Machinery Manufacturing Company, variable frequency changer; Trumbull Electric Company, bus inclosure; Weston Instrument Company, speed indicators. Anaconda, General Cable, Habirshaw, Okonite and Simplex cables are used, and conduit was supplied by the Youngstown Sheet & Tube Company.



DISCHARGE SIDE OF SLAB-HEATING FURNACE



LINE OF FINISHING MILLS

RUN-OUT TABLES—In this picture appear about 100 variable-frequency motors on the individual roll drives

Bus Protection Gives Service Reliability

In spite of its simplicity, differential protection of bus sections is not common. Maybe the reason is a fear of improper relay actions traceable to a non-foolproof characteristic. Here it is shown that these fears are groundless and that costly damage can be averted cheaply with trustworthy and quick relaying. The goal of the article will be reached if each executive asks his engineer, "If no differential protection—why not?"

By PHILIP SPORN

Vice-President and Chief Engineer American Gas & Electric Company

THE idea of differential protection of equipment is not new—it has been employed, and quite generally and successfully, for years on alternators, transformers, synchronous condensers and similar equipment. The ideas of economical service and reliable service are certainly not new as desirable criteria by which to judge a utility's performance. But the differential protection of buses as a means of obtaining reliable electrical service economically is sufficiently strange and seemingly new so as not to have caught on. As a consequence we have had in many cases economical service; we have had reliable service, but in a great many others we have not had economical reliable service.

The essentials of differential protection practice are extremely simple. Basically you rely on the fact that the total incoming and outgoing currents in any section of bus are equal and in opposite directions under normal conditions. But, if a fault develops on the bus, the total incoming and outgoing currents are no longer equal and in opposite directions, the perfect balance is upset and you can then obtain a relay current calling for the immediate clearing of the equipment on the bus section in trouble. If this relay action is sufficiently fast it may be possible to, and it generally does, clear the equipment on a bus section before any material damage results.

Now all this does not sound complicated and it is not. That does not mean that a thoroughly sound technical job is not needed to carry out the fundamental idea properly, nor that some difficulties will not be encountered. These will be mentioned. But the point to keep in mind is that differential protection is not a technical fad, but an essential tool, and that it is comparatively inexpensive for the service it performs.

Perhaps as good a way as any of bringing home the foregoing is to examine in detail a typical example of differential protection. In Fig. 1 is shown the 66,000-volt, double-bus arrangement of a large modern steam plant. It will be noted that bus differential relays have been applied to the five sections of bus comprising the station layout and that all breakers and buses are normally energized. It is possible to do this safely and accomplish other things only because of differential protection. As a matter of fact, close analysis shows that the bus protection scheme adopted has made possible the following performance:

(a) Employ all four buses continuously, and in case of a bus fault occurring on any bus section no interruption will occur to any of the circuits.

(b) Bus short circuits or troubles are cleared in a relay action of approximately one cycle. The absence of long time arcs means the unlikelihood of any appreciable bus damage.

(c) Having the reserve bus operated continuously, which can be done under a differential scheme as the one outlined, definitely means greater certainty of availability

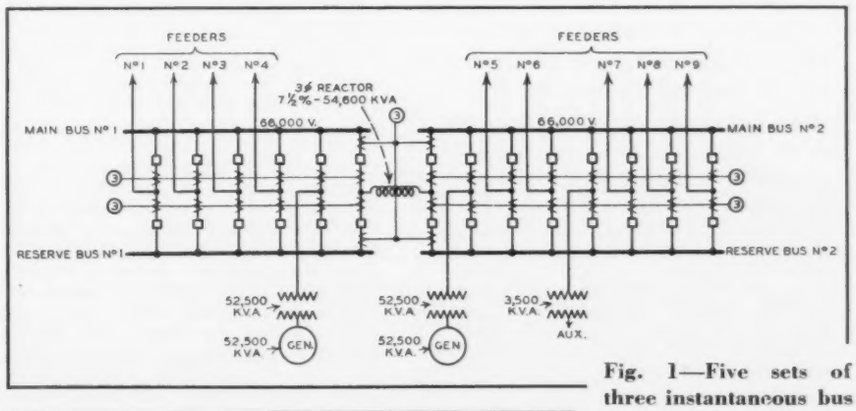


Fig. 1—Five sets of three instantaneous bus differential relays installed

All oil circuit breakers nominally operated closed. All five bus differentials are completely overlapped to obtain complete bus protection. In case of fault on any bus section the bus in trouble will be cleared instantaneously, causing no interruption in service to any of the circuits.

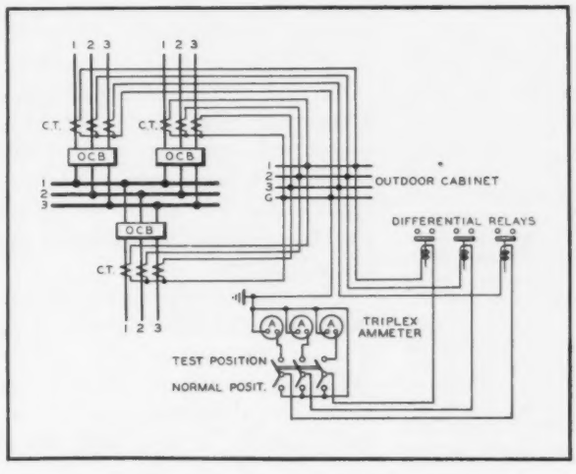


Fig. 2—Triplex ammeter installed with testing switch for checking unbalance of differential circuits

of one bus always whenever the other bus is in trouble.

Obstacles in no way serious

In a preceding paragraph attention was called to the necessity of doing a sound technical job. It is pertinent to ask, Exactly what are the difficulties? There are a number, but basically they integrate to this: The fear of an incorrect operation which would result in disconnecting of important apparatus or equipment when no trouble exists. Surprisingly enough, this fear of incorrect operation has not materially retarded the installation of differential protection on generators, large motors, synchronous condensers and power transformers. But in the case of busbars this has had a paralyzing effect on action looking toward installation.

The reasons underlying this fear are tangible enough and are:

1. Inequality in ratios of current transformers. On heavy overload currents this can produce sufficient unbalance current to operate the differential relay.
2. Open circuits occurring in the current transformers. This may give a differential relay action either on normal load current or on through short circuit.
3. Relay testing accidents. For example, an accidental opening of any one of the current transformers' secondary circuits which might result in improper relay action.
4. False operations due to some abnormal switching set-up which has the effect of disturbing the normal differential set-up.

Remedies have been found

All these are likely happenings, but the remedial measures to circumvent them have been worked out and have been found effective over a period of more than ten years. Specifically, to overcome possible difficulties due to any one of the four contingencies enumerated above, there can be applied the following:

1. To prevent inaccuracies of current transformers from causing false operations on through short circuits, it has been found advisable to choose the ratio of current transformers so that the maximum through short-circuit current obtainable will produce a secondary current of less than 50 amp. in any current transformer; most transformer designs generally hold their ratio up to that secondary value. This practice has been further reinforced by installing a cabinet in the case of outdoor yard practice, centrally located with respect to the various circuits, so that the length of secondary leads from each of the circuits to this cabinet is substantially the same, resulting therefore in a minimum unbalance due to unequal burdens. At this cabinet the various transformer leads are totalized and one set of common wires is taken to the switchboard for the differential relays.
2. To prevent false operation in case of an accidental opening of a current transformer it has been advisable to set the differential relays so that they will not operate on a current less than two times the normal load current taken by any circuit forming part of the differential group. Thus, even such an opening will not under normal load cause any mishap.
3. The problem of preventing false operations due to more or less permanent open circuits occurring in the secondary current transformer loads has been solved by providing in the differential relay circuit a 1-amp. ammeter normally not connected in the circuit. This is shown diagrammatically in Fig. 2. As will be seen, a test switch is provided that normally disconnects the meter from the circuit, which when flipped over to the test position connects the meter in the circuit and measures the unbalance current existing at any one time. At manually operated substations this testing is carried out by each shift, the operators being required to read the unbalance current on every differential ammeter the first thing they do when they come on duty. If the unbalance current is more than normal they are expected to cut the differential relays out of service and immediately call the relay engineer. In the case of automatic stations the reading is taken by trained test men periodically so that the unbalanced condition is detected before a through short circuit occurs and makes possible a faulty action.
4. To prevent false operation of differential relays due to abnormal switching set-ups, it has been found advisable to so interlock the differential relays that under any such set-up the relays are cut out of service automatically. This obviously means definite loss of the particular protection for a short period, but on the whole it has been found that this gave so much added confidence in the perfect functioning of the differential scheme that the loss of differential protection for the short period that the abnormal switching situation existed was well worth the price paid.

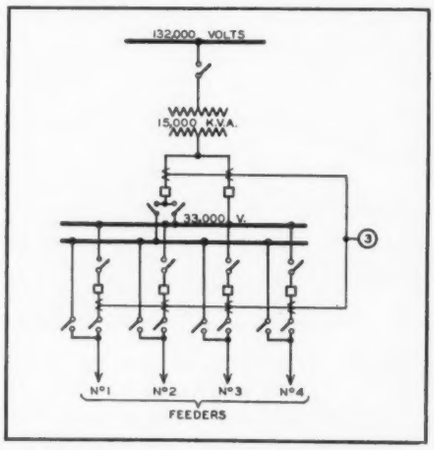


Fig. 3—Bus differential protection adapted to simple stepdown distribution substation.

Carried out along the above lines, differential relay protection of buses ceases to be a theoretical tool capable of boring a large number of practical pitfalls and becomes a sound protective scheme offering extensive operating advantages.

The theoretical considerations outlined above have been put to practical test on the system with which the author is associated. In the past ten years bus differential protection has been installed at practically all of the important substations from 11,000 volts up to 132,000 volts and at the present time the number of stations whose buses are so protected is very close to 150. Fig. 1, already referred to, represents the 66,000-volt bus of a large steam plant. The main buses of half a dozen other large steam plants are similarly protected. Most of these are 132,000-volt buses, although one is a six-unit main and auxiliary bus arrangement operated at 11,000 volts, with reactors between bus sections and a 30,000-kw. unit on each section.

However, the most typical station in the group of 150 mentioned above is the small subtransmission switching and/or distribution station operating at voltages between 44 and 22 kv., of which some 57 are bus differential protected. Of this group Fig. 3 is diagrammatically representative. This station is unattended and completely automatic. Therefore, universally fast fault protection is particularly needed, since if a bus failure should occur in it a good deal of wreckage would be bound to occur before either back-up protection or manual clearing of the circuit could occur. The differential protection, however, fully supplies this.

It would be expected that differential protection of buses would greatly improve performance and improve reliability of electric supply systems. Thus, not only is damage minimized by differential protection, but the shortness of the trouble means that customers' equipment served from stations other than the particular one in question is put to a minimum amount of disturbance. Further, the lessened damage ought to mean in general that the equipment, once the trouble has cleared itself, would be in shape to go back into service, even though some repairs of a permanent nature might have to be made at some convenient time subsequent to the fault occurrence. It is interesting to record that actual experience has fully borne this out and that on the system in question we have averaged approximately two cases of bus trouble per year. Yet in every case, due to the almost instantaneous (one cycle) bus differential protection, the trouble has been cleared so rapidly that on no occasion has extensive trouble or substantial damage resulted, with the consequence that the bus could be immediately re-energized. In other words, the net result of the protection scheme was that a very im-

[*Continued on page 99*]

Utilities Hold Gains Over 1935

Short Month, Longer Daylight, Cuts Revenue, But Leaves February 5.4 Per Cent Over 1935. Output Up 14.6 Per Cent.

REVENUE for electric light and power during February dropped 4.5 per cent below the peak attained in January to $171,219,500, according to the Edison Electric Institute, but surpassed the figure for February of 1935 by 5.4 per cent. A decrease from the winter maximum is normal at this time of the year, as the industry enters the period of diminishing earnings in the annual cycle. The movement continues virtually parallel with that of a year ago, but on a level about 5 per cent higher.

In contrast with the modest increase in revenue, energy production rose 14.6 per cent above the amount reported a year ago and the average daily output of 280,000,000 kw.-hr. was only slightly less than in January, while sales of nearly 7,000,000,000 kw.-hr. to ultimate consumers indicate a gain of 13 per cent in this item over February, 1935. Thus the demand for energy is seen to be advancing by leaps and bounds, if account is taken of the variations inherent in the lighting load, but the revenue is by no means keeping pace with it. This disparity is shown also by the totals for the twelve-month period announced by the E.E.I.: revenue from ultimate consumers, $1,938,865,900, is up 4.6 per cent over the preceding like period, but energy sales increased 10.3 per cent.

Only 34 per cent of the total production in February came from water power, against 37 per cent in January. With the output from this source somewhat less than it was a year ago and with larger total sales the energy from fuel-burning plants had to be stepped up 27 per cent.

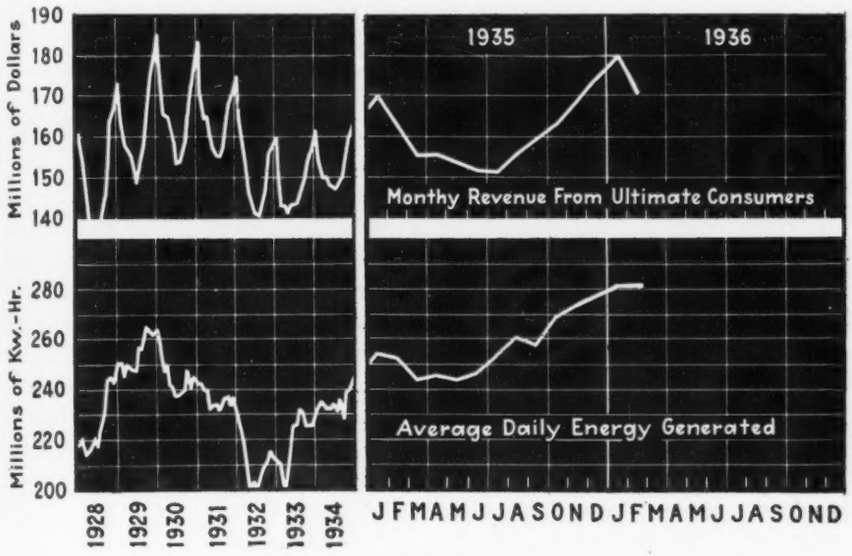


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1936	Revenue from Ultimate Consumers†		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
February	171,219	+5.4	8,120	+14.6	2,775	—2.2	5,345	+26.9
January	179,141	+5.3	8,745	+11.0	3,207	+3.3	5,538	+16.7
1935								
December	173,459	+5.9	8,580	+13.0	3,069	+1.0	5,511	+21.0
November	169,339	+5.5	8,207	+14.0	3,055	+9.1	5,152	+17.2

Table II—Regional Revenue and Energy Output in February, 1936

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	171,219	+ 5.4	8,120	+14.6	2,775	— 2.2	5,345	+26.9
New England	14,599	+ 4.5	547	+10.0	175	—27.7	372	+46.5
Middle Atlantic	49,406	+ 0.8	2,062	+13.7	436	—24.3	1,626	+31.6
East No. Central	40,732	+ 7.2	1,971	+14.3	142	—18.2	1,829	+18.0
West No. Central	14,523	+ 5.4	511	+ 5.5	105	—31.0	406	+22.6
South Atlantic	21,991	+ 8.4	1,051	+23.0	622	+14.3	429	+41.5
East So. Central			353	+ 7.5	282	0	71	+55.5
West So. Central	9,051	+ 6.0	373	+14.2	11	—54.5	362	+19.9
Mountain	4,944	+ 8.8	263	+17.8	176	+13.0	87	+29.0
Pacific	15,973	+11.3	989	+18.8	826	+18.8	163	+20.1

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central station.
†Preliminary, Edison Electric Institute.

Rates still declining

Consumption by all classes of users was larger than a year ago, as Table III indicates. Commercial sales, both retail and wholesale, gained more than 13 per cent, approximately as in January, but in the case of wholesale energy the advance is less hectic than it was last fall when the rate ranged around 20 per cent. Domestic sales continue their gains of 10 per cent, or better, over the preceding year.

The average domestic rate for the twelve-month period, dipping under 5 cents in January and still falling, is down to 4.96 cents. Domestic customers number 21,104,166; total 25,418,229. Both are new records. The year's increase was about 600,000.

Table III—Allocation of Energy February, 1936

Compared with Corresponding Month of Previous Year
(Edison Electric Institute)

Class of Service	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	8,026	+13.9
Lost in transmission, etc.	1,027	+20.1
Sold to ultimate consumers	6,999	+13.0
Domestic	1,340	+10.6
Com'l, small light and power	1,324	+13.7
Com'l, large light and power	3,514	+13.2
Municipal street lighting	219	+ 2.7
Railways—street, interurban	435	+11.2
Railroads—electrified steam	95	+54.0
Municipal and miscellaneous	72	+46.5

*Generated, purchased from other sources, imported, less energy used in railway and other departments.

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Co-operate to Buy T.V.A. Power

FEDERAL dams and power houses in the Tennessee Valley are facts accomplished. When installed the power will be used, even if it is necessary for the federal government to subsidize the activities and compete with private utilities. What are the alternatives? One is a series of legal battles. The other is for all utilities in the surrounding region to offer to take the power at the dams and distribute it as part of their power systems. On a miniature scale these utilities should handle T.V.A. as Boulder was handled by the Western utilities. Of course they paid a premium for Boulder power, but there were larger issues at stake than a slightly increased cost of generation.

Why not offer T.V.A. a price for the power at the dams that is more than fair. Why not say, in many instances, that power will be sold at T.V.A. rates *plus* taxes. Electricity as a basis for the "more abundant life" will be made available to the people of the region in even greater quantities and in quicker time under this procedure because the utilities are staffed to distribute and to sell.

It is well known that T.V.A. hydro power is not firm power. It is like most hydro power, good only when supported by steam power and if used on large systems that can use the dump or secondary water power. Will T.V.A. ever get the legal right to build steam power plants to support the hydro? T.V.A. says the major reason it wants power is to give unlimited electricity at low cost to the region. Hydro power will not do this.

Adjacent systems to the T.V.A. are large utility enterprises—subsidiaries of several of the largest holding companies. These properties are selling rapidly, some even now are adding capacity. It is a good bet that loads on these systems will be made to grow rapidly enough to use the T.V.A. power as it comes into action in the next few years.

Here is a place for some large-scale co-operation and foresight. We can see no harm resulting from such an offer and many advantages. The T.V.A. dams are factual and legal accomplishments and our suggestion appears to be the logical way for utilities to meet the situation and for permitting the taxpayers of the nation to get some return on a precipitate and unjustified federal expenditure. It is a daring suggestion. But it is a positive instead of a negative approach to the T.V.A. problem.

•

The Rooster on the Old Red Barn

FOR LO, these many moons, a cold, discouraging wind has been blowing upon the utility companies unfortunate enough to be owned by private citizens. The rooster atop the old red barn has pointed persistently into the north. But have you noticed that recently he has wagged to the right a few degrees? Consider the present plight of the P.V.A. In case you have forgotten, P.V.A. was to be the Potomac Valley Authority.

Why is it that Passamaquoddy and its tide-power have passed from page one? Was it $100,000,000 a year that R.E.A. was going to throw into rural networks? Believe it or not, the new M.V.A. is experiencing difficulties in Washington committees. And what is the significance of the Milwaukee election? Unless our eyes deceive us, municipal ownership was rejected though Socialist Mayor Hoan went back into office.

Can it be that the old reliable rooster is about to signal "fair weather ahead?"

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The Business of Making Friends

AN ELECTRICAL man recently returned from the Pacific Coast. He brought back many impressions of the way the power companies are operating out there—their policies, personnel, properties and markets. But he found that he was thinking oftenest about a man. He was a district manager of the Southern California Edison Company in one of its important communities.

When the Easterner visited this city he was greeted in the California way. The important men of the locality gathered for luncheon to welcome him. He saw the town. Those are the kind of memories one brings back from that country. But the thing the traveler recalled most vividly was the relationship that existed between this power company manager and everybody else in town.

This man was not only popular but important in his community. The mayor, the police chief, the president of the Chamber of Commerce, the heads of the banks and of the big stores, the leading business men.

all called him by his front name. But it was not just that he was a "mixer." He appeared to be involved in everything that was going on. He not only "belonged," he was a leader in the affairs of the city. And therefore the power company also was in the center of the life of the community.

The memory had lingered because this very desirable state of affairs is so rare. It is rare because most power company men take a professional attitude toward their work. They feel that, being neither manufacturers nor merchants, it is all right for them to live largely apart in a world of electricity. Yet a power company is both a merchant and a manufacturer. Every citizen is its customer. No other local business is so deeply involved in community affairs, so intimately related to other local business men. It cannot live in isolation. It is hourly in need of friends.

The president who sits aloof in lordly grandeur, the treasurer who thinks only of finance, the chief engineer who concentrates his entire interest in developing kilowatt-hours, the general manager to whom all people are consumers, the sales manager who is too busy to work in the merchants' association—all these are overlooking one of their most important responsibilities. It is not easy for all men to mix. But there are executives in every utility who can take an active part in community affairs. And if any man who speaks for the company cannot do it as a neighbor and a friend—like this manager in California—it is the wrong man speaking. For an important part of the business of the power company is the business of making friends.

•

High-Voltage D.C.

INCREASINGLY high values of voltage always appeal to the imagination in pictures of further advances, industrial, technical and scientific. However, economic values of alternating voltage for long-distance transmission of power may not be expected to rise much further and, as a consequence, high volumes of alternating voltage, so easily realized by the step-transformer principle and liberal design of insulation, have found only limited usage in testing laboratories for flashover, breakdown, corona and similar experiments. The possible value of high-voltage d.c. has always remained in the minds of electrical engineers, though more or less in the background. Renewed attention has been drawn to it in recent years by improvements and developments in rectifying methods. An additional stimulus of interest has been given by the physicists, who in their need for the highest possible d.c. voltage for atom-smashing researches have turned their attention to some of the old-fashioned electrostatic methods of generation. One of the most promising of these is the Van de Graaff generator.

Another elegant application of the same principles now comes from the French in an article by Pauthenier and Moreau-Hanot (*Comptes Rendus*, 26, Dec. 23, 1935, page 1332), describing an experimental apparatus in which the moving belt of the Van de Graaff design is replaced by a rapidly moving column of air carrying a fine dust or powder in suspension. This is charged by passing over a group of parallel wires discharging under corona, is then carried into the interior of the accumulating sphere, where the dust particles discharge, then passes out and again through the blower fan, repeating its function in a closed circuit. The first experimental machine immediately developed 450 kv. and the method is said to have exceptional promise for the rapid accumulation of charge, and consequently for the development of power. The experiments are continuing.

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Another Little Headache

SOME 30,000 eye-sight specialists are being persuaded by the Better Vision Institute to become unpaid salesmen for the electric lighting industry. They prescribe to 5,000,000 patients a year, under a new technique are prescribing foot-candles as well as lenses, and they get no take for boosting the wattages of the dim-eyed.

Despite which, says D. L. R. Harris, eminent optician, the utility men look upon their co-operation with indifference based upon ignorance. "I personally do not believe that public utility executives have thoroughly understood the necessity for co-operation," he says—but he goes on boosting central-station lighting load despite their indifference.

An industry which needs popular good will as badly as we do would not be making a serious mistake to take cognizance of 30,000 highly esteemed professional men who contact and enhance use to 5,000,000 customers annually.

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Damage vs. Protection

A TREND to use more wood in transmission is influenced by the desire to increase line insulation levels by use of wood construction. Poles, guys, braces, crossarms and pins made of wood undoubtedly increase the insulation levels. If a large part of the impulse strength lies in the wood there will be a decrease in flashovers, but severe flashovers may cause mechanical damage to the wood construction, with a consequent outage time greater than would occur with another type of construction. And if pole ground wires are used, the insulation level is lowered even though the splitting of poles is decreased.

It would seem desirable to attack this problem by using a balanced design whereby maximum benefit is had from wood insulation, yet wood insulation will not be used at any point which is higher than the insulation level of the line.

Power and the "Nine Old Men"

LET'S interrogate the "milkman in Omaha." Why? Because his viewpoint is important, politically, and hence economically. Because what he thinks, right or wrong, will therefore affect every one of us for good or ill. The "milkman in Omaha" is the mythical reader for whom every line is written by the reporters of one of our great press associations. The idea behind this standing order from the press association executives is that no copy shall be sent over their wires that will not be understood by him, or will not interest him.

Let's ask him what has happened to the Roosevelt Administration's dream of federal power projects like T.V.A. all over the country, of complete government ownership and operation of the electric industry. He would reply somewhat as follows:

"Well, I guess they got the stuffing knocked out of them by that T.V.A. decision. Those nine old men stopped Roosevelt from giving us cheap electricity, for a while. But wait until after election. Roosevelt will appoint three or four new judges in his next term. Anyway, we will lick them somehow, even if we have to change the Constitution to do it."

If we rely on insurance company statistics, the milkman is probably right about three or four vacancies on the Supreme Court in the four years beginning January 1 next. But at the White House and inside the T.V.A. camp one will find no confirmation for any idea that the Roosevelt electric program had the stuffing knocked out of it. It still marches on, and is expected to march faster later on.

THE milkman is right, 100 per cent, if we consider only the obvious intent of the high court's decision. The court set a very sharply defined limit which should restrict federal development and sale of water power. That limit, clearly set forth, is that production of electricity must be "incidental" to the main object of the project, which object must be within the federal government's constitutional powers, and that any such electricity sold must be an "incidental" excess over needs on the project.

Put in another way, that decision would prevent the government from engaging in any power project unless the purpose was *not* to produce current, or to provide a yardstick which would have the effect of forcing electric rates charged by privately owned companies down, but primarily for some purpose having nothing to do with electricity whatever.

The "milkman in Omaha" errs in seeking the answer to this part of the question, because he runs into a curious tangle. It involves the difference between the letter of the law and the spirit of the law. It includes a difference of views about the Constitution—whether it is the dead hand holding us back from progress, or whether it is a sacred protection of our liberties, protecting the little states from the big states (for which the Senate was created), protecting minorities from temporary majorities—whether it is a solemn compact which made this country possible, or a straitjacket from which we must constantly seek to liberate ourselves.

Mr. Roosevelt's attitude on all these differences is perfectly clear. His reference to the "horse and buggy" days leaves no doubt. His favorite story right after the high court unanimously rejected NRA is abundant evidence. This was about a small town ordinance which provided for a grade crossing policeman. After several years the town was discovered to have had no legal authority to enforce this. So it was discontinued. But meanwhile, the President pointed out triumphantly, it had saved several lives.

ON THIS question of saving lives, of course, there is no answer. None was made. But the fact that he told the story *in connection with* the NRA decision is highly significant. If the law stands in the way of progress, get around it if possible. The end justifies the means. Especially if you find it difficult to repeal the law.

So we find Mr. Roosevelt himself, New Dealers generally, and the Tennessee Valley Authority in particular, utterly undisturbed about the T.V.A. decision of the Supreme Court. They care nothing about the spirit of this decision, and they see lots of ways to get around its letter. It's so easy to say the purpose is one thing, for the record, and have actually an entirely different purpose!

So T.V.A. is marching on, despite the fact that every one knows perfectly well that all of the dams save the original one—the only one figuring in the T.V.A. case already decided—were built primarily because of their power possibilities, the alleged objectives of navigation and flood control being decidedly secondary.

Actually, of course, the first dam was built for a national defense motive. Or, more accurately, from a "take-the-profit-out-of-war" motive. And it is well worth a little study from that angle. It is an excellent illustration of a kind of thing that happens frequently in our government. It revolves around the theory that profiteers are always eager to rob the government, which of course is true. But so often it goes on from there to the government spending millions of the taxpayers' money to prevent these wicked profiteers from making thousands of dollars profit. Always, of course, it is defended on the ground that it will save the taxpayers millions in the long run. But it seldom works. Generally the taxpayer pays through the nose.

In the case of Muscle Shoals, the idea was that the du Ponts were making too much profit on explosives. So the government spent millions developing a plant to make nitrates. That plan is now obsolete. Nitrates can be made more cheaply by other methods. Either for munitions or fertilizer.

So from a national defense standpoint it was a complete flop. But, having failed to prevent the munition makers from some possible future profiteering, the enterprise is now turned toward the same sort of objective against the electric industry!

In the same bit of passion against the munition makers, incidentally, which spawned Muscle Shoals as a nitrate plant, was authorized the West Virginia armor plate factory, aimed primarily at the Bethlehem Steel Company, then much advertised as a "war baby."

The untold millions poured into that West Virginia plant while Franklin D. Roosevelt was Assistant Secretary of the Navy proved a total loss. Not a square inch

—By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

of armor has ever been produced there, and probably never will be!

Also in the same period, horrified at the idea of the wicked Guggenheims exploiting the rich natural resources of Alaska, the government built a railroad at an admitted cost of $50,000,000 in that territory. The object was to open those resources to the little fellow. The railroad is 471 miles long, farther than from Washington to Boston. The total population along the entire line, including both terminals and including Eskimos, was 6,000 when it was built. It is now slightly less. Its operation has cost the taxpayers of the United States one million dollars a year ever since, not counting any interest on the $50,000,000 original cost, and of course no taxes.

IT IS mildly amusing—if you don't mind paying taxes to pay interest on government debt—to note that a 37-mile spur was built off this railroad to reach a government-owned coal field. On its completion the coal field was promply declared a naval coal reserve, to be saved for future military emergencies! Of course at that time the navy had long since stopped building coal-burning ships. Hasn't built one since. Has converted all existing coal-burning ships to oil burners.

Mr. Roosevelt was heartily in favor of that policy then. He has never changed his views, save perhaps to take on a particular dislike for the electric industry.

So it is not surprising that the other T.V.A. dams are going forward—that San Francisco is being threatened with dire consequences if it does not give up its contract for selling the surplus Hetch Hetchy power to a private company (despite the fact that the San Francisco voters have several times refused to approve taxing themselves to build a transmission line)—that the government will fight to the last ditch to loan money for construction by local communities of power plants to compete with existing privately owned facilities.

What is being misinterpreted throughout the country is the evident fact that the Mississippi Valley Authority Bill is not going to pass at this session of Congress—that Passamaquoddy is stymied—and, most important of all, that the P.W.A. type of relief work—"worth-while projects," if you please—are relegated to outer darkness so far as the new billion-and-a-half-dollar relief bill is concerned, by Presidential edict.

These are just eddies near the shore line. The main current is sweeping on—toward government ownership and operation of the entire electric industry eventually—assuming Mr. Roosevelt continues to have his way.

But let's look at these eddies. Quoddy is the most interesting. The President dumped it in the lap of Congress—saw it beaten twice in Senate committee by barely one vote, but did not move a hand to help it. Every one knows he could have kept it going without consulting Congress—with relief money. Also that he could have saved it in Congress had he wished to turn the heat on.

Some think that the President is really convinced—as Secretary Ickes always has been—that Quoddy was a mistake, and that he now wants to back away. But there has been a most interesting political situation in Maine. The popular Democrat up there is Governor Brann, but the President's favorite, up until recently, has been Representative Moran. The two dislike each other cordially. Moran got all the patronage, until recently, enemies of Brann having convinced the President that Brann's judgment was far from cold, especially when considering the ability and integrity of his own supporters. So the President had the army engineers working on Quoddy, and the political value of the project shrank amazingly. Now Moran is out of the picture, Brann is in high favor, is the Democratic nominee for the Senate, and the President talks vaguely to reporters about some new plan for Quoddy!

The Mississippi Valley Authority and the plan of some members of Congress to earmark a portion of the billion and a half for P.W.A. projects are in the same boat. At the moment the President wants to hold down a little on *authorizations* for new spending. They can come *after* election. Meanwhile he does not want to provide any more ammunition than necessary for Republican critics of the too-much-spending policy of the Administration.

AFTER election, with the four more years in office he confidently expects, that T.V.A. Supreme Court decision won't even embarrass his power program. It doesn't take an engineer to realize that dams operated for power purposes do not fit in with either flood control, navigation or irrigation. The main object for power is a constant flow of water through the turbines and nothing else. Which frequently, if not always, is precisely the opposite of what is desired for the three others.

So long as the present membership of the Supreme Court continues, so long will the avowed object of new dams be one or more of the three others. But the New Dealers look forward to changes in the high court, and of one thing you may be sure—to have a chance of being nominated for the Supreme Court in the second Roosevelt Administration, if there is one, the would-be appointee must take a very liberal view indeed of what the Constitution permits the federal government to do in generating and selling electric energy. He must come pretty close to sharing the view on this question of Senator George W. Norris!

NEWS OF THE WEEK

Rural Electrification Projects Halted in Virginia by Cooke . . . Sales Plans Dominate Exchange Meeting . . . U.G.I. Taxes Take 28% of Net Income . . . Hurley Announces Plan to Relieve Unemployment . . . Greenwood County Enters the Buzzard Roost Case

Cooke Suspends Work on All R.E.A. Projects in Virginia

Piqued by decision of State Commission, R.E.A. Administrator orders halt on all co-operative rural construction jobs in the state

Disregarding the wishes of the Federal Rural Electrification Administration and projects of the R.E.A.-financed Farmers' Rural Utilities, Inc., the State Corporation Commission in a formal order last week directed the Virginia Electric & Power Company to provide power service to thirty citizens in the Chancellor area of Spotsylvania County.

The order sustained the petition of J. M. Steck and the other applicants and told the Virginia Electric & Power Company "to complete its construction and install service at the earliest possible date."

The commission held that the Virginia Electric & Power Company could offer quicker and more economical service, since the proposed new development is but 5 miles from a V.E.&P. line, and the company has contracts with the prospective customers and more than half the necessary rights-of-way. Moreover, it was found that an emergency exists demanding earlier action than the Farmers' Rural Utilities, Inc., apparently can provide.

The commission thereafter took up the similar case brought on petition of Doswell citizens and decided this territory should be left to the Farmers' Rural Utilities, Inc.

F.R.U. is a co-operative financed by the Federal Rural Electrification Administration, and the latter has been very active in trying to hold the territory, although the federal government has no direct jurisdiction.

After the two cases were decided—one against the R.E.A.-supported corporation and the other in its favor—the commission disclosed that the R.E.A., while not a party to either proceeding, had strongly urged the commission to give the co-operative both the Chancellor and Doswell areas, saying that to give them to the power company would be to "skim the cream" from the project.

The Virginia Corporation Commission has no intention of discussing its policies with the Federal Rural Electrification Administration because the commission is a judicial body and not a policy-making body.

This was made plain when members of the commission declined to comment upon the action of Morris L. Cooke, R.E.A. administrator, who has ordered the suspension of all Virginia activities of the R.E.A. because the state tribunal refused the demand that the rural co-operative also be given Chancellor territory.

Only 30 prospective customers were involved in the case, but the administrator "cracked down" because the Corporation Commission disregarded his ultimatum.

Traditionally the commission has relied upon the General Assembly for its policies and has judged cases that come before it under the statutes upon their individual merits, just as do all state courts. So far as is known, the commission never has discussed a decision on which action has been taken. Cases occasionally are reopened because of new evidence, but all proceedings such as that in which the Chancellor extension was involved are handled as judicial matters. Litigants carry appeals from the commission's decisions to the State Supreme Court of Appeals, but there is never any discussion of a finished matter by members of the body.

Administrator Cooke intimated that he would keep Virginia activities suspended until he found out what the commission's intentions would be toward the R.E.A., but if the R.E.A. chieftain waits until he gets a policy out of the commission he may have to wait a full lifetime.

Peninsula counties of Virginia look to the Corporation Commission for the next move in the rural electrification program proposed by East Coast utilities.

The Rural Electrification Administration approved Saturday an allotment of $125,000 for an East Coast project, but ordered further action delayed pending "clarification" of the Corporation Commission's attitude toward the R.E.A. program.

Bernard Mahon, counsel for the Farmers' Rural Utilities, Inc., said on Wednesday that his client had as yet received no order from Cooke and was proceeding with its plans to build a power line to serve the Doswell area in Hanover County.

Fort Sumter Hotel, Charleston headquarters of Third Annual Conference last week of Southeastern Electrical Exchange

Wisconsin Checks on Rural Rates

Hearings have been scheduled for May 14, 15 and 16 by the Wisconsin Public Service Commission on orders to show cause issued against six larger electric utilities of the state as to why they should not file wholesale rates applicable to R.E.A. farm electric co-operatives.

The state rural electrification co-ordination committee has filed with the commission resolutions asking investigation of the wholesale rates of the Wisconsin Power & Light Company, Northern States Power Company, Lake Superior District Power Company, Wisconsin Public Service Corporation, Wisconsin Gas & Electric Company and Wisconsin Michigan Power Company.

Selling Plans Dominate Southeastern Electric Meeting

Make highest records in U. S. — Good neighbor policy on rural electrification — Georgia home-town contest

An organization that is making good strides and contributing greatly to its members. This is the characterization given the Southeastern Electric Exchange by J. G. Holtzclaw in his presidential address. More than 300 were in attendance at an unusually good meeting in Charleston, S. C., April 29 and May 1. President Holtzclaw also pointed out that utility men could repair storm and flood damage and overcome tangible problems

Southeastern Electric Exchange's brand new president, L. V. Sutton (left), beams upon all and sundry in company of L. W. W. Morrow, editor of "Electrical World"

and adversities, but they found it difficult to overcome the political enmity that strikes at the foundation stones of private enterprise. He urged unity in action and aggressive work to advance the industry.

An interesting paper on the Georgia Home-Town Contest was presented by O. M. Jackson and discussed by W. T. Christie. In this program sponsored by the Georgia Power Company more than 80 per cent of the towns served have entered into a contest for cash prizes to be awarded on the largest use of electricity and the largest increment growth in energy use during the year. The cities are classified into groups of about the same population and the cash prizes are to be devoted to any civic or charitable purpose the town fathers decide. Remarkable interest has been shown, as evidenced by quotations from local newspapers quoted by Mr. Jackson. The contest has been of great promotional value, a direct sales asset and a new development in better public relations.

Selling the low-use customer was a topic presented by E. W. Ashmead. Employee selling, the use of home-service girls and the adoption and sale of low-priced appliances were urged as the best methods to use. Larger size of lamps, the use of the new I.E.S. floor and table lamps and low-priced irons, percolators and fans were found effective. In 1934 Tennessee Electric Power had 55 per cent of lamps 60 watts or larger, but in 1936 the percentage increased to 72. For 50 cents down and 50 cents a month some 20,000 I.E.S. table lamps were sold. Thirty thousand $1.95 irons were sold in two years. As a result of these efforts minimum bill customers have decreased from 19.3 per cent in 1934 to 8.4 per cent in 1936, despite taking on about 13,000 new customers in the last two years.

The utility industry is going ahead, according to a splendid paper presented by M. O. Troy. He gave an analysis of sales, sales prospects and the developments that the industry now faces in load. He urged that manufacturing facilities be used at the best possible load factor and that steps be now taken to meet future demands. He estimated current needs as $500,000,000 to provide adequate service for loads now dormant but awakening rapidly; $100,000,000 to serve new loads added in 1936; $350,000,000 for replacement—a total of $950,000,000.

Tarleton Collier of the Atlanta *Georgian* gave an analysis of the present business and political picture. He decried the creation of class hatreds and the adoption of spending policies that lead to destruction. He had a rather pessimistic outlook on the future of this country if present administrative policies are followed.

O. M. Jackson of Georgia Power springs a new idea in telling of the Home-Town Contest

T. A. Busby (left) and Vice-President E. L. Godchalk of South Carolina Power Company, hosts of the convention at Charleston

The electric kitchen as a load builder was advocated by George E. Whitwell. Essentially, this is a creative idea to sell an assembly instead of separate items. It is modeled on the bathroom. The idea has sales promotion and business-getting value and should be used in some form in all areas. H. G. Isley gave a splendid paper on how dealers and utilities can aid each other in promoting appliance sales. H. C. Webb, Jr., outlined the current trends in power sales and advocated stronger support for the power sales department. Samuel G. Hibben gave an informative and illustrated talk on the expanding horizons of lighting.

Committee reports were given by the several standing committees: E. W. Ashmead on sales, E. S. Fitz on engineering and C. J. Curry on accounting. Much work is being done by each committee of great value to the member companies. Good examples were the pamphlet on distribution practices and the analysis and suggestions on the proposed classification of accounts of the Federal Power Commission.

A plea for more planning of distribution systems was presented by L. S. Smith. This part of the system represents a large part of the investment and needs careful planning to reduce costs and improve service.

Utilities should build rural lines and should do all they can to aid the farm co-operatives, said Graham Clayton in discussing rural electrification. He urged specialized rural salesmen to help farmers. He suggested the operation and maintenance of co-operatives by private utilities. A broad policy of aid, promotion and support of rural electrification is the one to adopt, in his opinion.

This was supported by that of Prof. C. E. Seitz of V.P.I.

N. G. Symonds gave a splendid talk on selling the industry to the public. L. W. W. Morrow showed data that proved the Southeastern area was building domestic business more rapidly than any other section despite the fact that the rate was not the lowest and the economic and territorial conditions about the worst. That this program is good business was proved by the fact that this section had the highest average annual revenue per customer in 1935.

Officers elected at the meeting were: L. V. Sutton, president; W. E. Mitchell, G. C. Estill and J. A. Longley, vice-presidents.

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Advanced Ideas at Cincinnati Exhibit

Thirty thousand visitors to Cincinnati's springtime Better Vision Exhibit, arranged under the general direction of Edward W. Hodgetts, lighting engineer of the Union Gas & Electric Company, were treated to an unusually effective display of the latest contributions of light to sight.

From the time the visitor entered the doors, surmounted by a searchlight eye pictured in last week's News Issue, until he paused at "Exhibit No. 11" for a home demonstration appointment card he was treated to a series of features distinguished by their appeal to Mr. Average Customer.

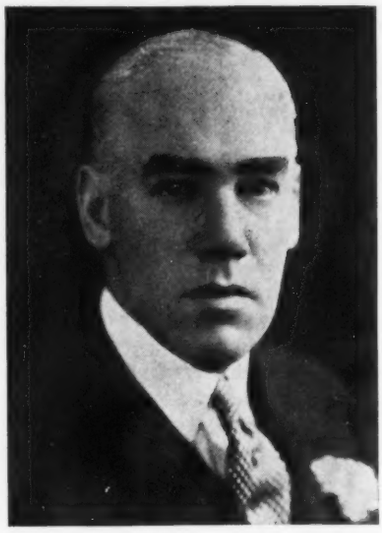
For example, at a light-intensity selector he adjusted by himself the amount of foot-candles and received a printed record to take home of the intensity he selected. So many people jammed the aisle at this point that it was necessary to have an attendant to speed up the recordings. A second display of light intensities consisted, not of drawings illuminated in standard display style, but of miniature dioramas, skillfully executed and lighted in rotation and in correct proportionate values.

The importance of colored walls and ceilings was shown by three-dimension exhibits, lighted alike, but the lightmeter in the brown room indicated only 15 foot-candles; that in the ivory white room, 55 foot-candles.

Rotating disks, school-book pages, glare exhibits, bead displays, patterned goods passed in review in this well-planned presentation of the lighting art of today.

Newspapers and electrical associations, oculists and optometrists, contractors and fixture dealers, interior decorators, paint salesmen and wall paper dealers, all were enlisted in achieving a job with such appeal that after the company has used the exhibit for display in nearby communities it will be taken to Cincinnati schools which have already requested it for educational use.

U.G.I. Tax Bill Unwieldy Burden



"Some twenty-eight per cent of the net income of our subsidiaries is now absorbed by taxes," President John E. Zimmermann told stockholders of United Gas Improvement Company at the annual meeting on Monday. "They give every prospect of being greater in future years," he added. Tax bill of $11,800,000 will be increased by another million dollars in 1936, Mr. Zimmermann predicted.

One indication of the unfortunate effect of ever-increasing taxes upon utility operations is the report of U.G.I.'s first quarter for 1936. Operating revenues of $26,666,133 were $1,039,320 above the first quarter of 1935, but net earnings of $10,955,224 were $220,107 below the first quarter of 1935. Approximately $1,250,000 extra was thus absorbed by taxes and other operating expenses.

The tax burden distributed over 917,000 electric and 408,000 gas customers of U.G.I. subsidiaries amounted in 1935 to $8.72 per customer, or $1.21 more per customer than in 1934, Mr. Zimmermann said.

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White River Hearings Open

The Federal Power Commission on April 30 held a hearing on the license applications of the White River Power Company, a subsidiary of the Arkansas Power & Light Company, to construct three dams on the White River, and of the Current River Power Company, an independent utility, to build three dams on the Current River, in Arkansas and Missouri. In each case work would be started on at least one dam within two years of the granting of the license.

Opposition to the proposals was limited to a written protest by the White and Black River Flood Control Association and to Representative John E. Miller of Arkansas, who stated that he would not oppose prompt construction of the projects, but wished to be on record as opposing any long delay.

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Utility Adds to Plant

Keystone Public Service Company, serving Franklin, Titusville, Oil City and other Pennsylvania communities with electric power, has awarded contracts for construction of a $350,000 addition to its power plant in Oil City. J. A. Redfield, general manager, announced that the new building will cost $45,000 and equipment $305,000.

Better Highway Lighting Urged

Illumination of cross-country highways as a means of reducing accident toll was urged last week by J. M. Strike of the St. Joseph Railway, Light, Heat & Power Company, speaking before the Missouri Association of Public Utilties at St. Louis.

Calling attention to the enormous toll of motor vehicle accidents on the country's highways of more than 36,000 deaths annually, Mr. Strike said statistics of the Auto Accident Prevention Association showed proper illumination of highways materially reduced the number of accidents. He emphasized the need for an engineering study of the problem, which is closely connected with the question of rural electrification.

Other members of the accident prevention committee who spoke were Albert A. Rall, Kansas City Power & Light Company; E. R. Kropp, Union Electric Light & Power Company, St. Louis, and John J. Barada, Laclede Gas Light Company, St. Louis.

Walter D. Ladd, manager of the St. Joseph Safety Council, told the meeting Missouri lagged behind many states in safety work, there being little emphasis placed on it outside the three largest cities.

"The wave of agitation for safety has succeeded in impressing people with the idea that things are in a terrible state," he said. "Unfortunately, they are not being told what they can do about it."

Co-operation by utilities and other business firms through their employee and

safety courses, including driving, in the schools were possible means of promoting safety, he said.

Speaking contest

An employees' speaking contest was held in which nine identified with six utilities, winners of competitions in their own companies, competed. First prize of $50 each went to Miss Dolores Milburn of the Union Electric Light & Power Company, Webster Groves, and Vall G. Herber of the Gas Service Company, Kansas City. Second prizes of $25 each were awarded to Miss Lillian Butterfield of the Central Distributing Company, Kansas City, and Fred M. Sholders, Kansas City Power & Light Company.

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Milwaukee Predicts Big Appliance Sales

Based on a co-ordinated program of the electrical industry in Milwaukee, of which the Milwaukee Electric Railway & Light Company is the nucleus, sales of appliances in the Milwaukee metropolitan area are expected to show an increase of 40 to 50 per cent in 1936 as compared to 1935.

The industry has set an objective sales total for the year as follows: Two thousand ranges, 1,200 water heaters, 10,000 refrigerators, 12,000 roasters and 15,000 better sight lamps. This total would have an aggregate retail value of $2,380,000.

A survey by the Milwaukee Electric Railway & Light Company shows that currently 43,000 homes in the Milwaukee metropolitan area have electric refrigerators, while 163,000 are without them; 9,000 have ranges and 197,000 have not; 1,800 have water heaters and 204,200 have not; 8,000 have ironers against 198,000 without them; 155,000 have washers but 51,000 have not, while 127,000 use cleaners and 79,000 lack them. The saturation point is most nearly reached by radios, with 196,000 homes having them compared to 10,000 without.

An added market for electrical consumption is seen in the fact that 1,200 new homes are expected to be erected this year and 5,000 farms in the territory now without service will be equipped during 1936. Residential use of electricity amounts to only approximately one-sixth of the Milwaukee Electric company's delivered energy.

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Chicopee Contract Approved

Chicopee's fifteen year contract to purchase electric energy from the Holyoke Water Power Company was approved last week in the Superior Court at Springfield, Mass., in findings, rulings and order for decree dismissing a suit brought by taxpayers to prevent the plan from going ahead (ELECTRICAL WORLD, January 4, page 100). Attorney John P. Kirby, representing the plaintiffs, said an appeal to the Supreme Judicial Court was likely. The present contract with the Turners Falls Power & Electric Company expires July 31.

Prominent Manufacturer to Attack Unemployment Problem

Edward N. Hurley announces tested plans for free instruction of 50,000 American youths in rudiments of selling after approval of applicants by dealers or public utility companies.

Plans for taking 50,000 of the country's great army of unemployed youth and setting them on the road to self-respect and self-support are announced by Edward N. Hurley, Jr., Chicago, president of the Electric Household Utilities Corporation. Mr. Hurley coupled his announcement with a call to America's manufacturers to join him in a program which he declared will go far toward alleviating "the most serious phase of our great unemployment problem" by furnishing work to the idle youth of the country.

Mr. Hurley's own part in his proposal for the rehabilitation of young manpower will be a practical sales instruction course that he will give free to 50,000 young men. It is designed to make any youth at least partly self-supporting almost from the time of his qualifying, and its effectiveness in this respect has been revealed by exhaustive field tests throughout the country in the past ninety days, it is said.

"The shocking condition of having 4,700,000 youths not in school, unemployed and seeking work, as just revealed by the American Youth Commission, demands the most earnest attention and promptest possible action by the manufacturing world," said Mr. Hurley. "These boys are the heads of tomorrow's families. Their station will largely govern the country's buying habits and volume through the next twenty to thirty years. If they are not directed now into useful channels of productive activity, they and their families will be a drag on American society and industry through decades."

Local indorsements

Enrollment requirements will be kept at the minimum as a means of putting the greatest possible number of boys to work in the least possible time, Mr. Hurley declared. The applicant is required only to be at least 18 years old and to have the character indorsement of his minister, priest or school principal and his home public service company or electrical appliance dealer. If it is not practical for him to obtain such indorsements, he may apply direct to Mr. Hurley.

Another Search for Power Market

Creation by the present Congress of a federal power agency in the Pacific Northwest to take over the marketing of power from the Bonneville project, and eventually also from Grand Coulee, has been recommended to President Roosevelt by the National Resources Committee. The recommendations of the committee are based upon a recent report of the Pacific Northwest Regional Planning Commission, composed of the chairmen of the state planning boards of Idaho, Montana, Oregon and Washington, together with the district chairman of the National Resources Committee.

It is suggested that the new agency might well consist of three members appointed by and responsible to the President, with authority over the distribution of power and the establishment of rates to promote its broad regional use. It would be authorized to build transmission lines and to purchase or condemn land.

In addition to the Pacific Northwest Regional Planning Commission report and that now submitted by the National Resources Committee, it will be recalled that only last week the State Planning Board of Oregon issued a report of a preliminary investigation of the possible uses of Bonneville power. (ELECTRICAL WORLD, May 2, page 3).

Just to add to the galaxy, Senators McNary and Steiwer in the meantime introduced a bill providing "that for the purpose of improving navigation on the Columbia River, the dam, locks, power plant and appurtenant works, now under construction at Bonneville, Ore. . . . shall be completed, maintained and operated under the direction of the Secretary of War and the supervision of the chief of engineers." An identical bill has also been introduced in the House by Representative Pierce.

County Enters the Buzzard Roost Case

Greenwood County, S. C., asserts that Ickes did not initiate project and that Duke Power Company questions have already been decided by legal authorities

Greenwood County, South Carolina, which owns the P.W.A.-financed project planned for Buzzard Roost, has entered the legal controversy encircling the proposed $2,852,000 project by filing a brief with the Supreme Court asserting that Duke Power Company was "entirely mistaken when it even 'suggests' that the government or the P.W.A. in any way initiated or encouraged" the undertaking of the project.

"The Public Works Administration did not force Greenwood County to enter competition with the Duke interests or even abet them in so doing," the brief stated.

Attorneys for the county asserted in the brief that the question of the right of Congress to make appropriations for the "general welfare" had been settled by the recent case of the Hoosac Mills, in which the Supreme Court overthrew the A.A.A. Duke interests, it was asserted, had no standing to question expenditures of federal funds for construction of the project.

Much as Greenwood County may be disturbed at the possible loss of almost $3,000,000 to be expended in the project, the Supreme Court has not yet stated whether it will review the Circuit Court opinion which dissolved the Duke Power Company's injunction against the use of federal funds for building competitive dams.

Should the court consent to a review of the decision, it is believed arguments could not be heard until the October term.

•

Santee-Cooper Data Requested

U. S. District Judge J. Lyles Glenn granted a motion to three power companies to require the South Carolina Public Service Authority to clarify its answer to their suit against the Santee-Cooper power project.

The plaintiffs seeking an injunction against the proposed $37,000,000 power and navigation project are the South Carolina Power Company, the Carolina Power & Light Company and the Broad River Power Company. Arguments were heard on the suit and answer, which were filed some weeks ago.

The plaintiffs contended the defendants had spoken of "certain" loan and grant agreements and Judge Glenn ruled that the authority should state how much money has already been granted and give its "honest belief" as to what the total might be.

The power companies asked to be told how the project would affect navigability of the lower reaches of the Santee-Cooper and Judge Glenn ruled the authority should be specific in this answer also.

•

Rural Program for Mississippi

Looking toward early inauguration of a proposed rural electrification program in Mississippi in conjunction with the Tennessee Valley Authority, Governor White appointed last week a state board of directors of the Rural Electrification Authority. The board, created under an act of the recent Legislature, will administer a proposed electrification program as contemplated in five companion measures which the Legislature also approved. It is composed of Evon Ford of Taylorsville, Jeff Kent of Forest and Ernst Long of Ripley and will hold its first meeting soon.

The board is empowered to issue revenue bonds, enter into contracts and promote organization of power associations in counties or rural communities, and serve as an agency to contract with the T.V.A. for power and transmission lines.

COMING MEETINGS

Refrigerating Machinery Association—Spring meeting, Hot Springs, Va., May 14-16. D. Norris Benedict, president, 915 Southern Building, Washington, D. C.

Air Conditioning Manufacturers' Association — Annual meeting Hot Springs, Va., May 16. P. A. McKittrick, president, 915 Southern Building, Washington, D. C.

National Electrical Manufacturers Association — Spring meeting, The Homestead, Hot Springs, Va., May 17-21. W. J. Donald, managing director, 155 E. 44th Street, New York.

National Battery Manufacturers Association — Spring convention, Statler Hotel, Cleveland, Ohio. May 20-21. W. J. Parker, 7 East 44th Street, New York, N. Y.

Edison Electric Institute—Annual convention, Municipal Auditorium, St. Louis, Mo., June 1-4. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

International Union of Producers and Distributers of Electric Energy—Sixth congress, Scheveningen, Holland, June 10-20.

American Institute of Electrical Engineers — Summer convention, Huntington Hotel, Pasadena, Calif., June 22-26. H. H. Henline, national secretary, 33 West 39th Street, New York.

Society for the Promotion of Engineering Education—Annual meeting, University of Wisconsin, Madison, June 23-26. Dr. F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

American Society for Testing Materials—Annual meeting, Chalfonte-Haddon Hall, Atlantic City, June 29-July 3. R. E. Hess, assistant secretary, 260 South Broad St., Philadelphia, Pa.

Third World Power Conference—Washington, D. C., September 7-12. Joel Wolfsohn, executive secretary, Interior Building, Washington, D. C.

Wilson Dam Lines Bought by T.V.A.

The transmission lines reported to have been the basis of the now-famous Wilson Dam decision, holding that the government could utilize transmission lines to transmit power from the dam to the market, changed hands on May 1 for a payment by T.V.A. to Alabama Power Company said to amount to about $1,150,000.

The sale included only high-tension lines and did not include any of the utility's distributing systems in Tennessee Valley cities. Sale of these is held up by another injunction brought by the stockholders' group and now pending in the federal courts. For the time being the T.V.A. will sell power to the Alabama Power Company on a "city gate" basis.

Under terms of the contract the T.V.A. will also furnish interchange power until the middle of next year, when a new arrangement will be made.

In commenting on the announcement that the sale had been closed, Thomas W. Martin, president of Alabama Power, said: "It was agreed in the contract that T.V.A. would not sell electric energy outside the area in northwest Alabama therein described, and would not take or solicit the company's business beyond that area until after completion of Norris Dam." Continuing, he stated that threats of government competition "have a serious effect on the company's rates by making it impossible for the company to refinance its bond and preferred stocks on the present money market."

•

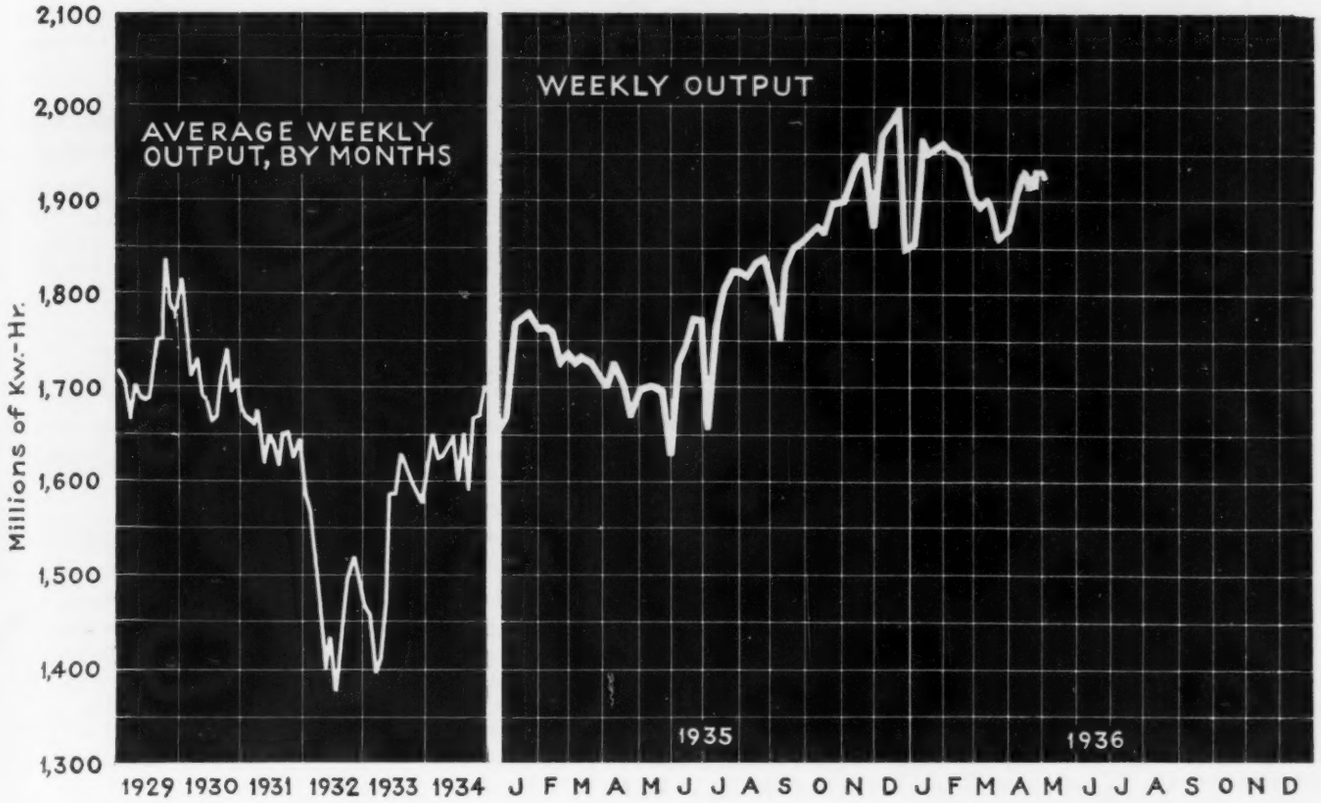
Duke Power Loses Tax Case

In a decision handed down this week by the U. S. Supreme Court the Duke Power Company and its subsidiary, the Southern Public Utilities Company, lost its fight against the 1932 South Carolina tax on electric power (ELECTRICAL WORLD, May 2, page 9). The court declined to review a ruling January 6 by the Fourth Circuit Court of Appeals, which upheld the act.

Henry A. Morss

Henry A. Morss, president and treasurer of the Simplex Wire & Cable Company, died May 6 in Boston, Mass., after a short illness. Mr. Morss was born in Boston 65 years ago and was graduated from the Massachusetts Institute of Technology in 1893. He spent his entire business life in the wire manufacturing field. Mr. Morss was a former treasurer of M.I.T., a member of the executive committee and a life member of the corporation.

Output 13.6 per Cent Above Week's Record



Surpassing the record for the like period in any earlier year by 13.6 per cent, the output of central stations for electric light and power during the week ended May 2 reached 1,928,803,000 kw.-hr., according to the Edison Electric Institute. A year ago the output matched that of 1930, which up to that time had stood as the maximum for the beginning of May.

The present excess over the period of 1929-1930 is the greatest thus far attained and with one exception the increase over the preceding year is the largest recorded since last November.

Last week's decline compared with the preceding week was insignificant; the output was slightly larger than the average for April and considerably above the average for March. A rising trend at this season is abnormal.

Progress is being maintained in all parts of the country. In the Central industrial area the large percentages over the preceding year, noted last fall, are being approached.

Per Cent Change from Previous Year

Region	Week ended May 2	Apr. 25	Apr. 18
New England	+ 9.7	+10.6	+13.9
Middle Atlantic	+ 9.7	+15.5	+10.0
Central Industrial	+14.4	+17.4	+12.3
West Central	+14.3	+13.9	+11.5
Southern States	+15.0	+13.5	+11.7
Rocky Mountain	+22.1	+25.9	+15.8
Pacific Coast	+17.6	+16.9	+16.5
United States	+13.6	+15.5	+12.5

Weekly Output, Millions of Kw.-Hr.

1936	1935	1934
May 2...1,929	May 4...1,698	May 5...1,633
Apr. 25...1,933	Apr. 27...1,673	Apr. 28...1,669
Apr. 18...1,915	Apr. 20...1,702	Apr. 21...1,673
Apr. 11...1,934	Apr. 13...1,725	Apr. 14...1,642
Apr. 4...1,916	Apr. 6...1,700	Apr. 7...1,617
Mar. 28...1,867	Mar. 30...1,713	Mar. 31...1,666
Mar. 21...1,862	Mar. 23...1,725	Mar. 24...1,658

March Output High Despite Floods

An increase of 11 per cent compared with the like month of 1935 is indicated by the output of public utility plants in March of 8,915,579,000 kw.-hr. reported by the U. S. Geological Survey. The average daily production was 3.0 per cent less than in February, the change being slightly smaller than the normal decrease of 3.5 per cent from February to March. Production from water power, 3,772,776,000 kw.-hr., was 42 per cent of the total.

As can be seen from the accompanying table, operations continue to be on a materially higher level than a year ago, the average gain for the latest six-month period being 13 per cent, with new records established for the respective months. The decrease in average daily production from 298,000,000 kw.-hr. in January and 295,000,000 in February —with monthly totals of 9,257,000,000 kw.-hr. and 8,602,000,000 kw.-hr., respectively—to 288,000,000 kw.-hr. in March shows the usual seasonal effects of longer daylight and higher temperatures, with flood conditions added in some regions, notably New England.

Gains Over Previous Year, per Cent

	Nov.	Dec.	Jan.	Feb.	Mar.
United States	+14	+13	+11	+15	+11
New England	+10	+ 9	+ 3	+ 9	— 1
Middle Atlantic	+10	+11	+ 8	+15	+10
E. No. Central	+18	+18	+13	+14	+13
W. No. Central	+19	+ 4	— 2	+ 6	+ 5
South Atlantic	+23	+16	+20	+23	+18
E. So. Central	+ 1	+16	+ 9	+ 9	+ 9
W. So. Central	+12	+14	+10	+16	+13
Mountain	+15	+14	+19	+17	+19
Pacific	+14	+14	+14	+18	+12

Stock Issue Approved

Approval has been given by the Federal Power Commission to the application of the Montana-Dakota Utilities Company for the issuance of stock. The company proposes to issue 17,739 shares of 6 per cent series preferred stock in exchange for a like number of 7 per cent stock now outstanding, and to issue also 59,592 shares of 5 per cent series preferred stock, 46,704 of which are to be issued in exchange for a like number of 6 per cent series preferred stock now outstanding. The remaining 12,888 shares are to be issued to the preferred-stock holders in the par amount equal to 20 per cent of their present holdings for the purpose of funding cumulative preferential dividends in arrears on such outstanding preferred stock from January 1, 1932.

Utility Stocks Advance Slightly

Light and power stocks moved within a narrow range this week. Slight gains were sufficient to carry the "Electrical World" index to 34.8, compared with 34.6 last week.

New Ruling Issued on S.E.C. Exemptions

The Securities and Exchange Commission has published a new rule with respect to acquisitions of public utility securities by others than members of non-exempt holding company systems.

The rule provides certain exemptions from Section 9(a) (2) of the Holding Company Act, which requires approval by the commission of acquisitions of public utility securities by persons who, either before or as a result of the transaction, own 5 per cent or more of the voting securities of the company whose securities are acquired and 5 per cent or more of the voting securities of any other public utility holding company.

The new rule exempts from commission approval: (1) Acquisitions where both the acquiring company and the issuer of the security acquired (and the subsidiaries of each) are organized within the same state, and where specified proportions of the assets and business of each are within that state; (2) acquisitions by persons who, as a result of the acquisitions, will not own, control or hold 10 per cent or more of the security acquired and either will not be holding companies or will be intrastate holding companies or holding companies otherwise exempted from registration, and (3) acquisitions of securities of foreign companies by persons who are not affiliates of any American public utility company.

Acquisitions exempted under this rule, except as to securities of foreign companies, are to be reported to the commission within 30 days.

It is expressly provided that this rule shall not be construed as granting an exemption to unregistered holding companies unless they are otherwise exempt from the requirement of registration.

•

Tax Probe Fund Voted in New York

By a vote of 58 to 5 the New York City Board of Aldermen authorized last week the issuance of $203,000 of corporate stock as requested by the Board of Taxes and Assessments to cover the expense of investigating the public utility companies' properties. The inquiry has reference to the ability of the companies to pay the 3 per cent utility tax that the city has imposed and seeks to draw a larger sum from the companies by endeavoring to show that their properties have been previously undervalued.

•

Tax Rate at New High

Wisconsin's tax assessments on utilities for 1935 are at the highest rate ever recorded, $22 per $1,000 of assessed valuation, and will yield $7,337,050 on a valuation of $331,304,650, according to the state Tax Commission. Milwaukee Electric Railway & Light's $2,768,241 bill is the largest.

•

Merger in Vermont

Application has been filed with the Federal Power Commission for approval of the merger of the Stamford Light, Heat & Power Company with the Green Mountain Power Corporation. Both of these companies are now controlled by the New England Power Association. The companies state in their petition that approval of the merger will result in all retail electric companies now controlled by New England Power Association in Vermont being owned by one corporation, resulting in the elimination of one corporate organization and simplification and economy of operation.

•

Beauharnois Bondholders Name Protective Committee

Holders of Beauharnois Light, Heat & Power Company first mortgage bonds, series A, 5½ per cent, due in 1973, at a special meeting held in Montreal recently elected a bondholders' protective committee of five members to investigate and take such action as deemed necessary in the situation created as a result of the cancellation of the company's power contract with Ontario Hydro-Electric Power Commission.

•

Western Power Plan Approved

At a special meeting held last week Western Power Corporation stockholders voted to increase the capitalization of the company by issuance of 98,600 additional shares of common stock. This was the first step in the plan for liquidation of the company (ELECTRICAL WORLD, April 25, page 60).

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Utility Merger Approved

Consolidation of the Union Gas & Electric Company and the Cincinnati Gas & Electric Company has been approved by the Ohio Public Utilities Commission.

•

Square D Quarterly Net Totals $122,232

For the quarter ended March 31 net profit of the Square D Company, after federal taxes and other charges, totaled $122,232, equal to 25 cents each on 220,650 shares of class B common stock now outstanding, after deducting the regular quarterly dividend of 55 cents a share on 123,170 shares of class A preferred stock. There was a $132,135 profit in the first quarter of 1935. For twelve months ended March 31, 1936, net profit was $716,581, or $2.02 a share, on outstanding class B common stock, after deducting the full annual dividend of $2.20 a share on the class A preferred stock. The company's only subsidiary, the Square D Company of Texas, will be operated as a branch of the company instead of as an independent company.

•

Line Material Net Up

For the year 1935 Line Material Company and subsidiaries report net profit of $194,625 after charges, compared with net profit of $99,791 for 1934.

MANUFACTURING AND MARKETS

G.E. to Feature Farm Service

A new campaign designed to demonstrate the advantages of electricity for farm use is about to be launched by the General Electric Company of Nela Park, Cleveland. Along with widespread advertising and merchandising efforts, G. E. distributors everywhere will feature throughout the summer the latest developments created by General Electric to aid the farmer electrically.

In connection with this move, the first book of its kind on modern electrical refrigeration for farm use has just been printed. It is available through the General Electric Company without cost.

The whole technical field of farm refrigeration is made easy for the layman to understand in simple, concise language. Any one operating a truck, fruit, dairy or poultry farm or butchering meat for sale or home use will find a complete array of information on his own particular problems.

In addition to the many other interesting details brought out in the new book, there is an offer of a free survey service, conducted by trained General Electric engineers, which enables any farmer to find out quickly and easily just what it would cost to put modern electrical refrigeration on his farm.

•

Link-Belt Appoints New Distributor

Link-Belt Company, Chicago, announces the appointment of Industrial Supplies, Inc., Memphis, Tenn., as authorized stock-carrying distributors of Link-Belt elevating, conveying and power transmitting chains and machinery, Caldwell screw conveyors and fittings, antifriction bearing units and complete silent and roller chain drives. Ample stocks are to be carried in Memphis to serve the trade with dispatch.

•

Interior Wiring Booklet Progresses

Seventy per cent of the new material prepared for the handbook on Interior Wiring Design is approaching final form, according to E. A. Brand, chairman of the Joint Industry Committee on Handbook of Interior Wiring Design.

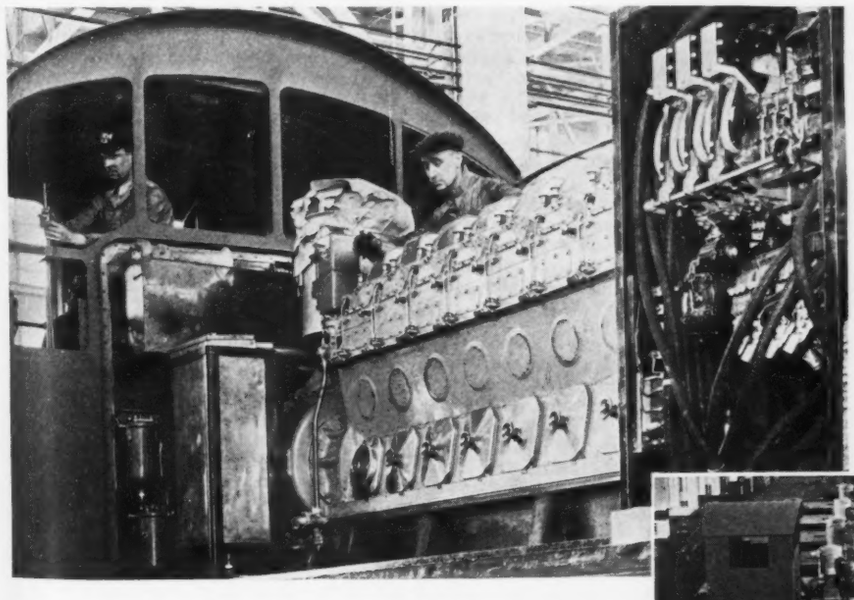
Some sections of the book have already been reviewed by the subcommittee in detail. It is planned to have a two-day session of the technical group the first weeks in May, at which time a detailed review of the majority of the remaining material can be accomplished. It is further hoped that the completed document can be available for review and approval by the committee as a whole in June, and that approval of the various national associations which are involved will then be secured during the summer. If this schedule can be adhered to the completed handbook should be available next fall.

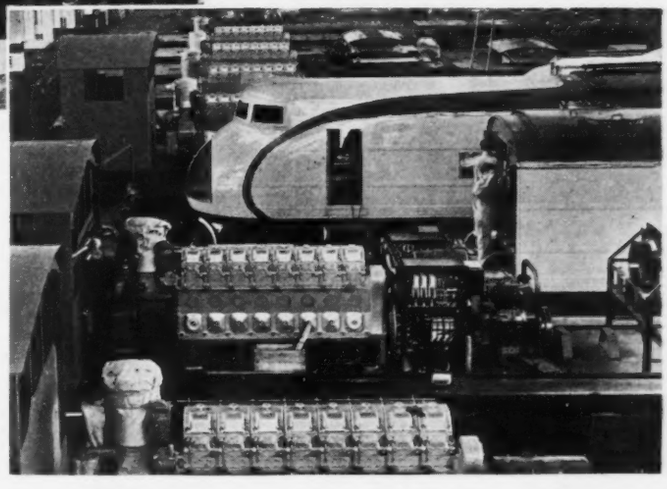
•

New Westinghouse Unit Now in Operation

The new air-conditioning manufacturing division of the East Springfield works of the Westinghouse Electric & Manufacturing Company has been put in operation on a small scale for the manufacture of the larger type of equipment utilizing two, four and six-cylinder motors, with the cooling plant in the basement or some other remote place. Production of the self-contained units for independent room-cooling will be started later.

NEWEST MARKET FOR ELECTRICAL EQUIPMENT

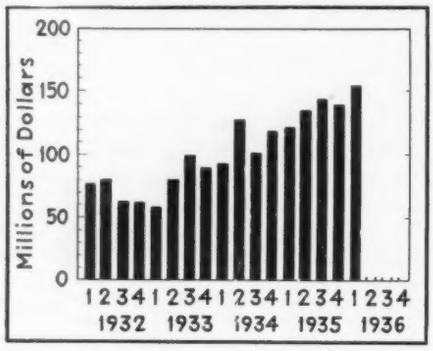




Here are six Diesel-electric switching locomotives in course of assembly in the erection shop of the Electro-Motive Corporation at LaGrange, Ill., with a streamliner and another not so streamlined thrown in for good measure. This scene illustrates a market for electrical rotating and control equipment that is bound to attain very large proportions within the next few years. This promise gains weight from the close-up view in which a part of the control installation appears at the right. According to H. L. Hamilton, president, the corporation started its first production this spring with $3,500,000 worth of orders on the books.

Orders 26 per Cent Above 1935 Value

Orders for electrical goods during the first quarter of 1936 were the largest in aggregate value for any like period since the middle of 1931, according to statistics announced by the Bureau of the Census. As reported by 78 manufacturers, bookings totaled $153,452,432, compared with $121,814,226 a year ago and $139,012,116 in the fourth quarter of 1935. The amount was 2.65 times as great as in the first quarter of 1933 and it surpassed the figure for the corresponding period of 1931 by 5 per cent,



Quarterly bookings, 78 manufacturers

but was exceeded in the second quarter of that year. The totals include data for electric motors, storage batteries, domestic appliances, industrial equipment, and other electrical apparatus and supplies. They are presented as being sufficiently representative to indicate the trend but not as a complete statement of the industry.

•

Factory Payroll Jumps

Brisk business for Kelvinator is reflected in the announcement that March factory payrolls were 74.3 per cent above the same month last year.

•

Larger New York Quarters For Allen-Bradley

Substantial business increases during the past year have made it necessary for the New York office of the Allen-Bradley Company, Milwaukee, manufacturer of motor control equipment, to move to larger quarters in the Underwood Building at 30 Vesey Street. For years the Allen-Bradley New York office had been located at 50 Church Street. In its new and more spacious quarters Allen-Bradley will be able to carry a complete consignment stock of motor-control equipment, thus assuring customers in the New York area even more rapid service.

New York Metal Prices

	Apr. 29, 1936 Cents per Pound	May 6, 1936 Cents per Pound
Copper electrolytic	9.50*	9.50*
Lead, Am. S. & R. price	4.60	4.60
Antimony	12.625	12.75
Nickel ingot	35.00	35.00
Zinc spot	5.275	5.275
Tin Straits	46.625	46.875
Aluminum, 99 per cent	19—21	19—21

*Delivered Connecticut Valley

Leonard Shipments Spurt

Shipments of Leonard electric refrigerators in March rose 153 per cent to 18,113 units, compared with 7,166 in the like 1935 month, according to R. I. Petrie, sales manager. For the six months ended March 31 the total was 33,952, against 20,149 a year earlier, Mr. Petrie stated.

Field Reports on Business

Field reports to ELECTRICAL WORLD *on business conditions indicate that there has been some moderate recession, but that nothing has occurred which would presage more than a normal summer decline. Production of steel ingots, electric energy and automobiles is lower, though hardly perceptibly. Foreign fears and Washington activities complicate the picture, but sentiment remains favorable.*

CHICAGO

General business activity last week displayed further evidence of the strong fundamental character of the spring rise by extending that advance while a recession was expected. The advantage gained was slight, but was accomplished in the face of seasonal recessions in many lines and established current activity at a point considerably ahead of 1935.

Orders for electrical equipment continue to rise in all lines. The demand for motors and control apparatus is steady. A manufacturer of metering devices reports the best quarter in five years. Another reports a nice order for transformers and voltage regulators. Proposals are being received on a job involving 20,000 lb. of weatherproof line wire. A substantial increase has been noted in air-conditioning activity as the season advances.

Statistics from Chicago electrical wholesalers show an increase in sales of 25 per cent over the previous month and 28 per cent ahead of the same month last year. A gain of 24 per cent was registered for the first quarter over the same period a year ago.

Residential construction continues forward at an encouraging pace as new projects are announced each week. Evidence of increasing interest in building is shown by the large attendance at several model homes now open.

NEW ENGLAND

Less interest in heavy electrical equipment and somewhat spotty buying of small motors was reported in this district during the past week. While sales of power apparatus were confined to small motors in single lots for the most part, inquiries continue to maintain a steady trend; one manufacturer records a sale of a small group of motors to a textile company; fractional-horsepower motor sales have fallen off, according to one manufacturer; an encouraging activity among machine tool and grinding machine manufacturers which has accounted for a number of motor and control apparatus orders recently is noted.

Line materials are moving regularly and in steady volume; recently pole and crossarm orders were quite active for replacements resulting from flood ravages. Wiring devices for residences are selling well due to unusual activity in the building of homes in the Greater Boston area. Street-lighting equipment orders recently reported include 40 special units for the new Fore River bridge; floodlighting projects include the border lights and field floodlighting for the Boston Airport and Suffolk Downs racetrack. Show window lighting has become more active.

NEW YORK

The first week of May has been marked by slight recessions in industry and talk of the customary summer let-down. Decided optimism marks most predictions for the second half of the year, however, and there is little disposition to feel that the hot months will see any more than a mild reaction (jittery stock prices notwithstanding).

The steel and electric energy output figures are typical of the present trend. Ingot production has edged off from the spring peak in the first decline since the March floods, but the trade's reviews feel that no precipitate decline is in the cards. Power production has also dipped a trifle and the rate of gain over a year ago has been pared to a little over 13 per cent. The narrowness of these declines is strength in itself.

The foreign situation is disturbing, the Washington news provides no great assurance. These, however, are about the only real disturbing elements.

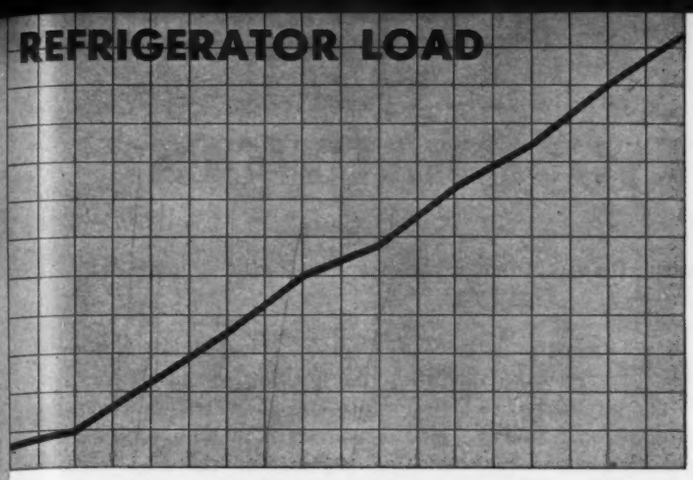
PACIFIC COAST

Business from power companies is outstanding, chiefly comprising bare and weatherproof copper wire, conduit, pole line hardware, but also covering smaller quantities of wiring staples. Rural electrification and mining requirements, especially reopened areas, are largely accountable in Utah for this demand, but general run of orders for maintenance elsewhere is the answer without any extraordinary conditions.

Pacific Gas & Electric Company reports January to March, 1936, appliance sales under F.H.A. plan to have totaled $3,185,201, with each month running 50 per cent above its predecessor. Refrigerator sales are nearly doubling those of last year. Electric ranges, too, are in heavy demand, especially in Glendale, Salt Lake City and East Bay sections.

A bumper crop year, such as now seems assured, will reap the fruits of many educational years covering farm, vineyard and orchard electrical devices. Railroad business is excellent, an instance being the steady employment of 600 men in the Sacramento shops for the relighting, air-conditioning and radio equipment of club and dining cars.

Building construction volume in San Francisco is nearly 60 per cent over last year for first four months; in Los Angeles about 45 per cent. Electrical business for same period is 50 per cent better this year in southern California and the Northwest, 25 per cent better in northern and central California and 40 per cent better in Utah.



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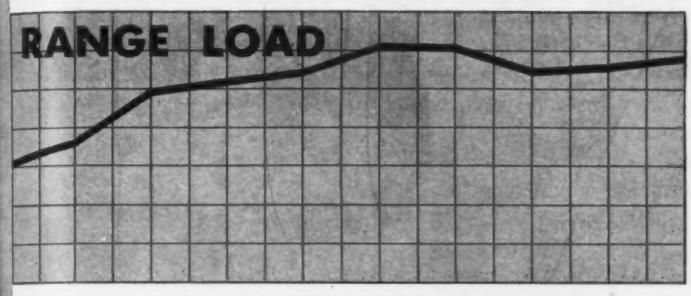

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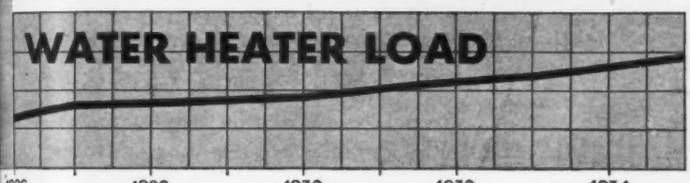
CONCERTED EFFORT IS PUTTING THESE OVER



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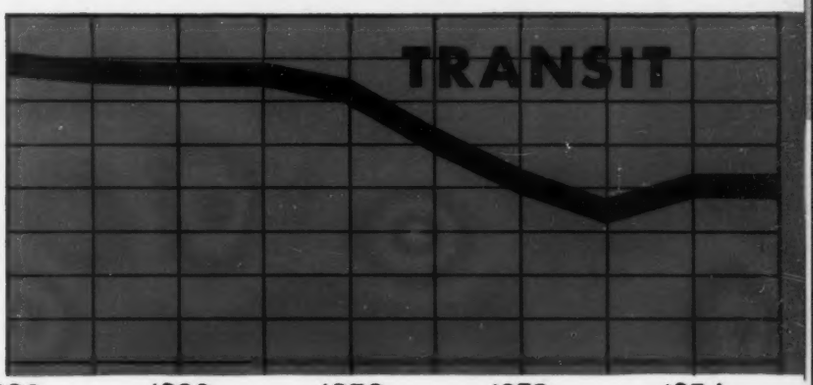
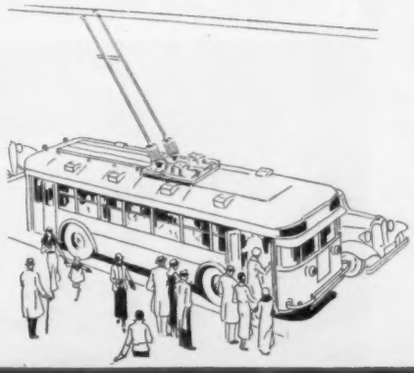
But....

HERE'S ANOTHER LOAD CURVE . . AND IT NEEDS YOUR ATTENTION



BECAUSE an annual load of 2 billion kw-hr is at stake. It has been slipping away—into the gasoline-bus field. It can be saved—by the installation of modern electric transit equipment.

The trackless electric coach—there are hundreds now in service in 30 cities—is the best answer to the public-transit problem in many situations. It affords transportation immeasurably more attractive than do most public vehicles now in use. It preserves present investment in transit facilities. From the standpoint of power load, even the smallest trackless-trolley line is the equivalent, in revenue dollars, of hundreds of electric appliances.



We urge more consideration of the importance of the transportation power load—lost whenever electric drive is abandoned. We invite you to get better acquainted with the modern trackless electric coach—which can help you preserve this load. And we suggest that you work with transit operators—one of your best power customers—on behalf of electric transportation. We are co-operating and have had a large part in making the electric coach a success. General Electric Company, Schenectady, New York.

232-14

GENERAL ELECTRIC

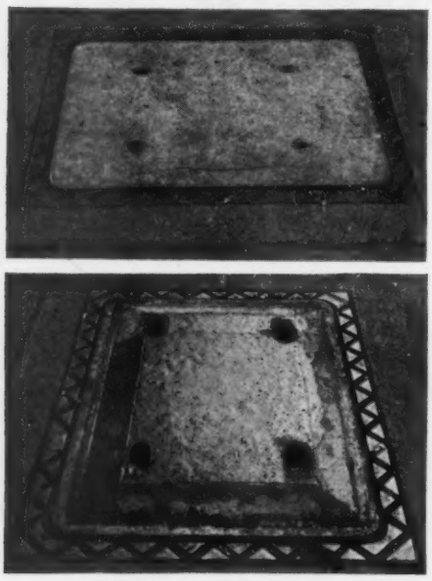
FIELD OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Service Box Cover of Reinforced Concrete

By J. M. COMLY
Assistant Engineer
Brooklyn Edison Company

Advantages claimed for a new reinforced concrete cover which has been developed for sidewalk service boxes by the Brooklyn Edison Company are:



Concrete cover strong and good in appearance

Above—In place. Below—Inverted. Tests made on this cover while supported as in a service box frame showed that failure occurred when 6,000 lb. load was applied to an area 4x17 in. in the center of the cover. New York City requires sidewalks to be designed for a uniform load of 300 lb. per square foot. As the area of the concrete cover is a little less than 5½ sq.ft. the 6000-lb. test indicates a good factor of safety.

1. The cost is considerably less than that of the cast-steel cover used for street service boxes and somewhat less than that of a light cast-iron cover used for sidewalk boxes.
2. It blends more nearly with the sidewalk in which it is set than do the metal covers.
3. It weighs less than either the cast-steel or cast-iron covers.

It is made with an angle frame to which is secured an expanded metal reinforcement and pry hook and hole castings. The concrete is poured into the frame so that it surrounds and covers the reinforcement and castings. Lamp black is mixed with the concrete in such proportions that the color of the mixture is approximately the same as the sidewalk.

When a new sidewalk service box is being built a light angle iron frame is installed to support the concrete cover. This frame is much cheaper than the standard cast-iron frame used for street boxes and manholes, yet it is sufficiently strong to give proper support to the sidewalk cover. The dimensions of the cover are such that it will fit either the standard cast-iron frame or the light angle frame. It is, therefore, possible to remove cast-steel covers from existing sidewalk service boxes for service in the street while concrete covers are placed on the sidewalk boxes.

•

Frequency Changing From Mobile Unit

By D. C. STEWART
Niagara, Lockport & Ontario Power Company, Buffalo, N. Y.

A problem encountered in changing over to 60 cycles customers served at 25 cycles from long radial 11-kv. feeders supplied only from one end was solved by the Niagara, Lockport & Ontario Power Company through use of a portable frequency changer station. Two large trucks, shown in the accompanying illustration, house the portable equipment. One truck contains a 120-kva., 25 to 62.5-cycle frequency changer of low voltage. The second truck carries two transformer banks, one for stepping down from 11 kv., 25 cycles and the other for stepping up to 11 kv., 62½ cycles. Equipment on these trucks is tapped in on the portion of the 11-kv. line still supplying 25-cycle power and the energy converted to 60 cycles for use on the portion of the line already changed over.

Meanwhile, a 60-cycle bus had been set up at a temporary station to serve feeders already changed over to 60 cycles.

•

Reduces Expenses 40 per Cent

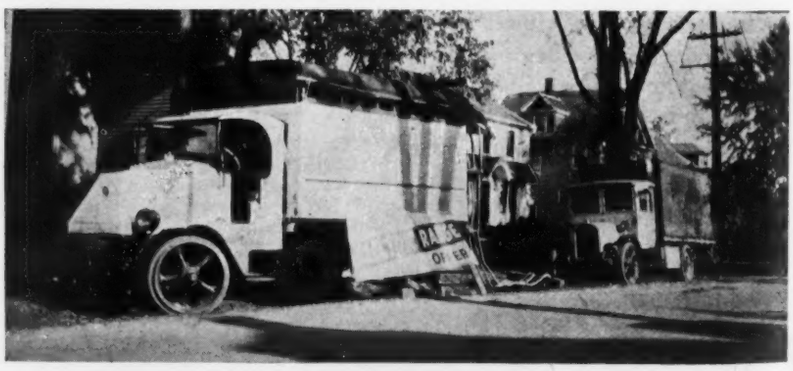
By S. B. TAYLOR
General Superintendent Transportation Department, Philadelphia Electric Company

Compared with 1930, when the internal transportation expenses of the Philadelphia Electric Company were $1,500,000 a year, these expenses in 1934 had been cut to only $900,000, or a saving of $600,000 a year. At the earlier date the company used 900 cars and trucks.

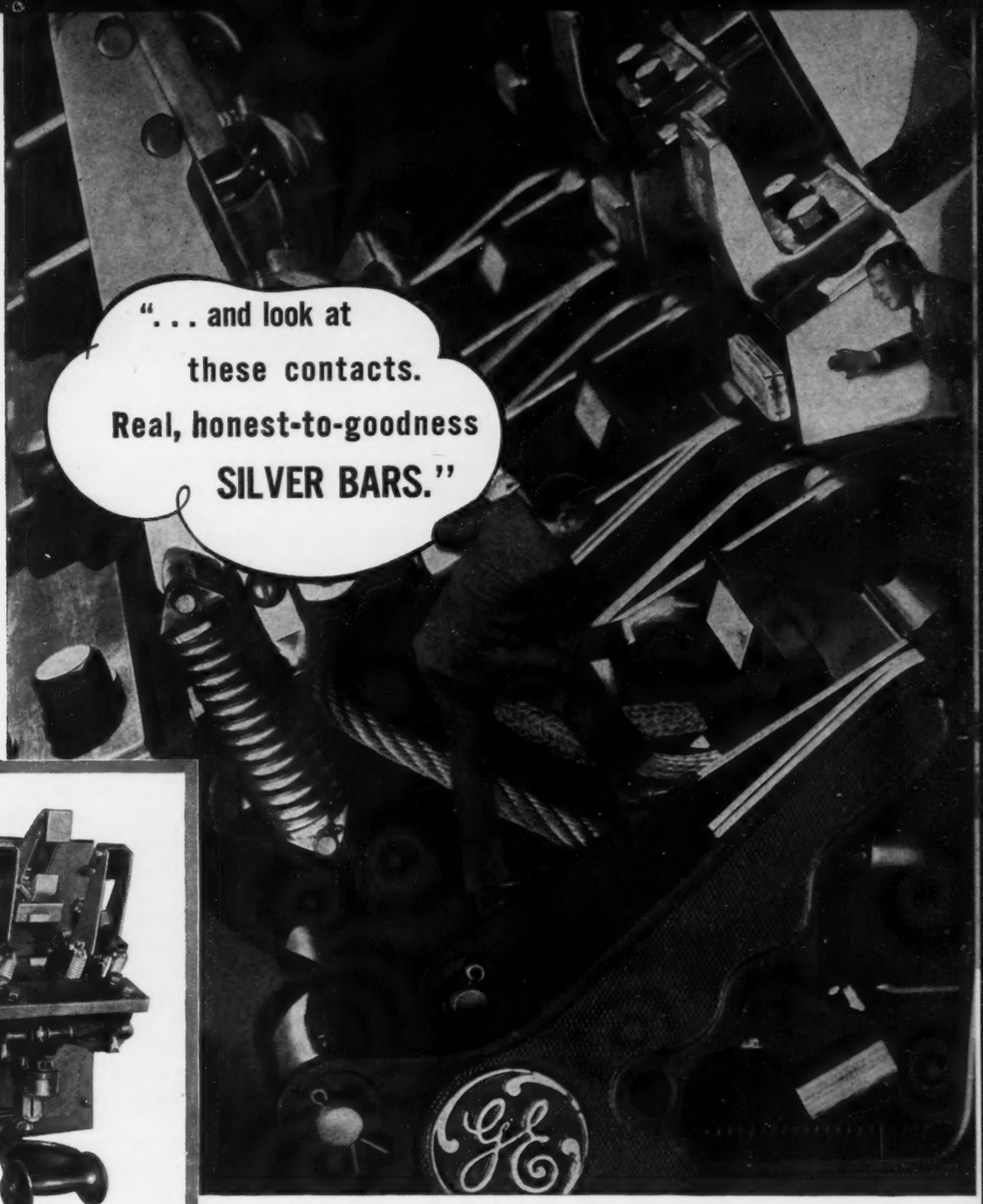
Part of the saving has been effected by discontinuing the assignment of individual cars except to a very few. Cars are now assigned on a taxicab basis so as to make maximum use of the investment, minimize taxes and licenses. Street cars and trains are being used more.

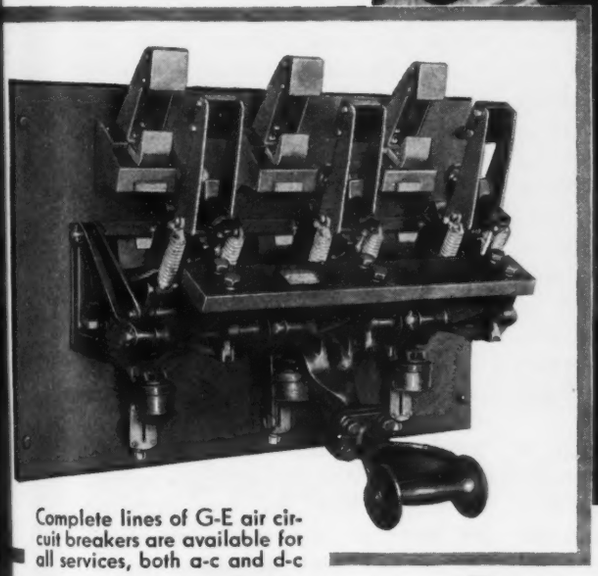
Whereas a few years ago many passenger cars, costing from $1,200 to $1,700, were used, these have now been eliminated and cars of the Ford and Chevrolet class are furnished to all except members of the executive staff, managers and department heads.

Whereas 5-ton trucks were formerly



Frequency-changing station mounted on trucks facilitates change-over





Complete lines of G-E air circuit breakers are available for all services, both a-c and d-c

For Better Protection

THE main contacts of G-E air circuit breakers are silver. And they're solid, welded to solid copper. Long-wearing contacts that will stand up under repeated operation.

In service, these contacts give G-E breakers three operating advantages that users value:

1. **Superior performance**—because silver eliminates troubles due to high-resistance oxidation and consequent overheating.

2. **Minimum attention**—because solid, silver contacts require less cleaning and less frequent replacements.

3. **Longer life**—because of the permanence of solid construction.

Get these advantages of solid, silver-to-silver contacts. Specify G-E breakers. General Electric, Schenectady, New York.

860-5

GENERAL ELECTRIC

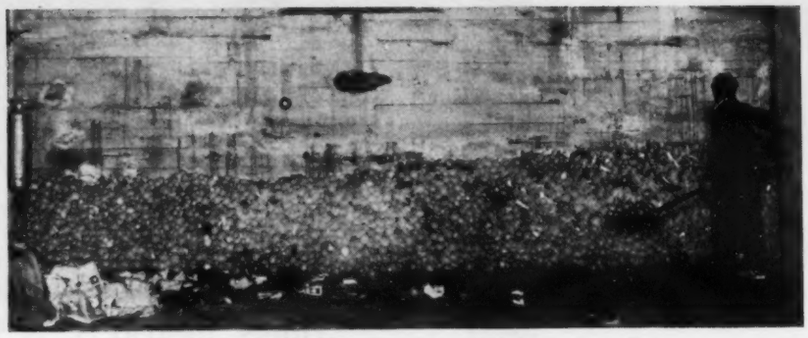
used extensively for construction work, they are not needed so much any more. To supplant them, in many cases it has been found possible to use 1½ to 2-ton trucks with less expensive equipment and considerable savings have been effected in gas, tires, maintenance and license fees. In co-operation with other departments, it has been found possible to reduce loads in many other classes of service, such as appliance service, gas fitting, gas mains and service and electric meter. As a result, vehicles assigned to these services have been reduced in size, with resultant savings.

Opportunities have been found to use trucks jointly for various services; namely, street light maintenance and customers' trouble calls, traveling headquarters of metermen and transporting heavy meter testing equipment.

Governors on all vehicles have reduced accidents and consequently insurance premiums, have helped to reduce gasoline and oil consumption and have directly reduced tire wear and maintenance. Tire life has been increased by careful check of pressures and by making every tire damaged through abuse or neglect a subject of discussion with the head of the operator's department.

Decrease in maintenance expenses has resulted from careful and efficient supervision in the shops and particularly through extending the life of all parts to their ultimate. Better maintenance has also increased the economical life of vehicles with a consequent reduction in charges for depreciation reserve.

In conclusion, it should be said that these accomplishments would have been impossible without the co-operation of all those departments of the company using vehicles.



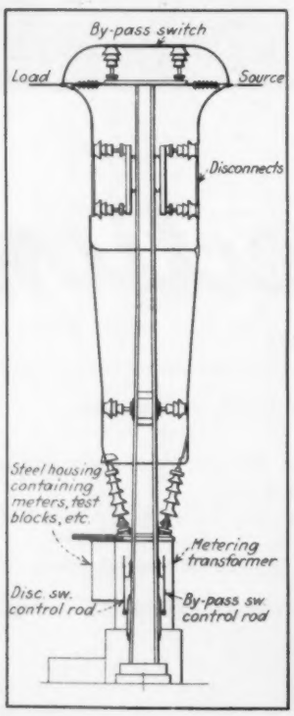
More than 50,000 lamps shoveled into this pile tested but 1 per cent bad

•

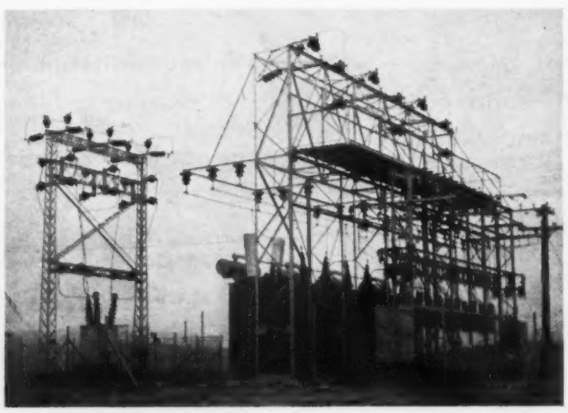
60-Kv. Metering Made Accessible

It was necessary to provide an economical and easily accessible metering arrangement for a 4,500-kva. load at 60 kv. so that periodic meter testing and examination of the metering transformers could be made without interruption to service. This requirement was met by installing between the supply and step-down transformer a 30-ft. steel tower with bypass and disconnecting switches which permit complete isolation of the metering equipment.

Metering is accomplished with a standard outdoor three-phase outfit rated at 70,000 volts, 60 cycles, 50/25.5 amp. current transformers and 600 to 1 ratio potential transformers. The necessary recording meters, reactiformer and test blocks are placed in a weatherproof steel housing.



60-kw. substation with high-tension metering equipment at left

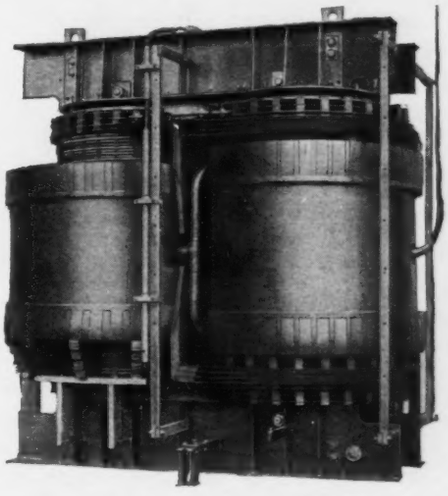


Salvaging Hartford Lamps

When the recent flood hit the Pearl Street office of the Hartford Electric Light Company there were 76,660 incandescent lamps in the basement stockroom which were completely submerged for close to four days. After the water subsided a chaotic scene met the eyes of rubber-booted employees who began to clear up the débris, shoveling the loose lamps which had escaped from their cartons against the wall and setting to work to salvage all they could with the initial aid of representatives of the Electrical Testing Laboratories, New York. The lamp stock varied in size from 6- to 3,000-watt bulbs, the prevailing size being 60 watts. Benches were set up on the floor and barrels brought in for use in cleaning.

Lamps were picked out from the pile by hand, taking 60-watt units first, and dipped in a solution of scouring powder and lukewarm water. After wiping they were placed in wire trays holding 75 bulbs each and dipped in hot water to remove silt, an electric immersion heater providing the required warmth. Two or three dippings were followed by wiping off, after which each lamp was given a 50-lb. torsion test with a standard bar outfit used in manufacturing, in order to check the mechanical tightness of the bulb and base. The final test was to check the condition of the filament by making contact of base terminal and side with two 115-volt brass strips attached to a portable wooden block, after which the lamps were restored to stock.

At the peak of the reconditioning period nine men were at work cleaning 700 lamps per hour, and only about 1 per cent were found defective, mechanical shock accounting for most of the trouble.



55,000-kva, 287-kv shielded-winding transformer

A BASIC PRINCIPLE . . . A PRACTICAL RESULT

Just as the snowshoe safeguards a man from sinking into the snow, by distributing his weight over a relatively large area, so does the "shield" on a G-E power transformer safeguard the windings by distributing the pressure of impulse voltage across them. "Shielding" definitely prevents the concentration of voltage stress. The practical result is exactly what one would expect from a sound engineering principle. Since 1926 more than 4,000,000 kva of G-E shielded-winding power transformers have been installed throughout the world, including localities where lightning is most prevalent, and there has not been a single failure of a shielded winding. We invite your inquiry concerning this outstanding service-assurance feature of General Electric power transformers.

All G-E power transformers 44,000 volts and above are now furnished with shielded windings.

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GENERAL ELECTRIC

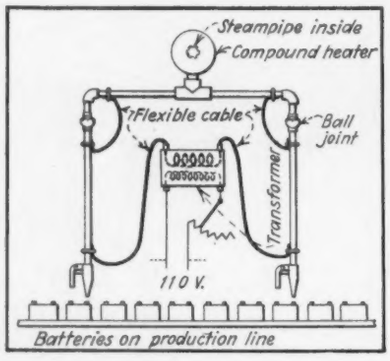
POWER AT WORK IN INDUSTRY

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Keep Seal Compound Hot Electrically

By DON L. SNOKE
Indianapolis Power & Light Company, Indianapolis, Ind.

Using a pipe as the heating element to facilitate the flow of a heavy liquid through it is the novel method employed in an Indianapolis storage battery factory. The asphalt-like compound with which the battery tops are sealed is warmed to fluidity in a large tank.



Compound pipes serve as heating element

By gravity the compound flows down to the production line station in about an 8-in. heat-insulated pipe inside, along the center line of which is a 2-in. steam pipe. The steam heat keeps the compound fluid in the run from the storage tank, but it does not help much in the ball-jointed down-drops ending in nozzles from which the compound is laid in the seams of the battery tops. The down-drop pipes are comparatively small in diameter and any usual method of applying heat to them would have made them very cumbersome to manipulate on the production line.

The problem was neatly solved as indicated in the accompanying sketch. The two down-drops, suspended from a tee, formed a closed electrical circuit for a low-voltage transformer secondary, the primary being energized from the 110-volt line through an adjustable rheostat. Thus, greater heat can be applied to bring the pipes up from the cold condition and then the current can be reduced with the aid of the rheostat just enough so that it will keep the compound flowing during production.

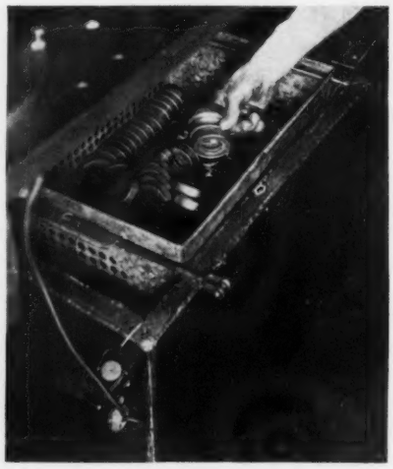
•

Electric Heat Used to Soften Leather

Specially constructed leather washers are used as grease seals in tractors built by the Cleveland Tractor Company. As manufactured these washers are so stiff that if they were installed without softening, their wear would be greatly accelerated by any irregularities, however slight, in the tractor shafts.

It is necessary, therefore, to soak the washers in a special oil. Only serious drawback to this treatment has been the length of time—48 hours—required at room temperature to insure the complete penetration of the oil into the leather.

To solve this problem, a new tank, steel-jacketed, and equipped with 2 in. of insulation, has been substituted to speed the soaking process by the application of a thermostatically controlled 2½-kw. immersion heater. Soaking time has been reduced from 48 to 2½ hours.



Tractor company treats leather washers with electrically heated oil; cuts penetration time 90 per cent

Electric Stripping Shovel for Mine

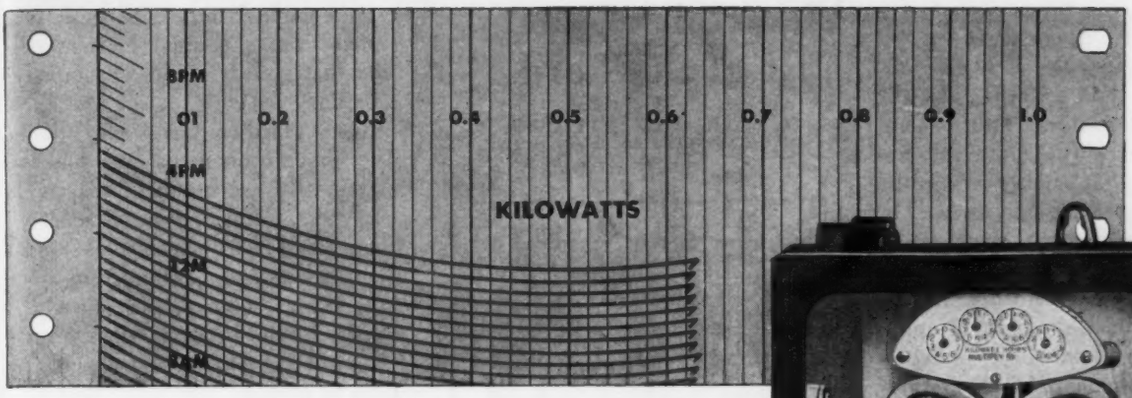
By GEORGE O. STEWART
Northern Indiana Power Company, Indianapolis, Ind.

Power to operate the monster shovel which appears on page 78 is purchased from the Northern Indiana Power Company through a 1,500-kva. substation stepping from 33 kv. to 4,160 volts, three-phase, four-wire.

This shovel, designated as type 950-B, was manufactured by the Bucyrus-Erie Company at its South Milwaukee plant. Instead of being equipped with the conventional type box-girder boom, it has an open frame boom that somewhat resembles the type ordinarily used on drag-line units. A cylindrical dipper stick, 3 ft. in diameter, and rope crowd are other distinguishing features. This shovel has a 105-ft. boom, 64-ft. dipper stick and a 30-cu.yd. welded alloy steel dipper. The dumping range is 106 ft. and dumping height is 70 ft. On this shovel the dipper is counterweighted, this operating in the structure to the rear of the shovel. Weighing in excess of 2,000,000 lb., the over-all height of this unit is approximately that of a modern fourteen-story office building.

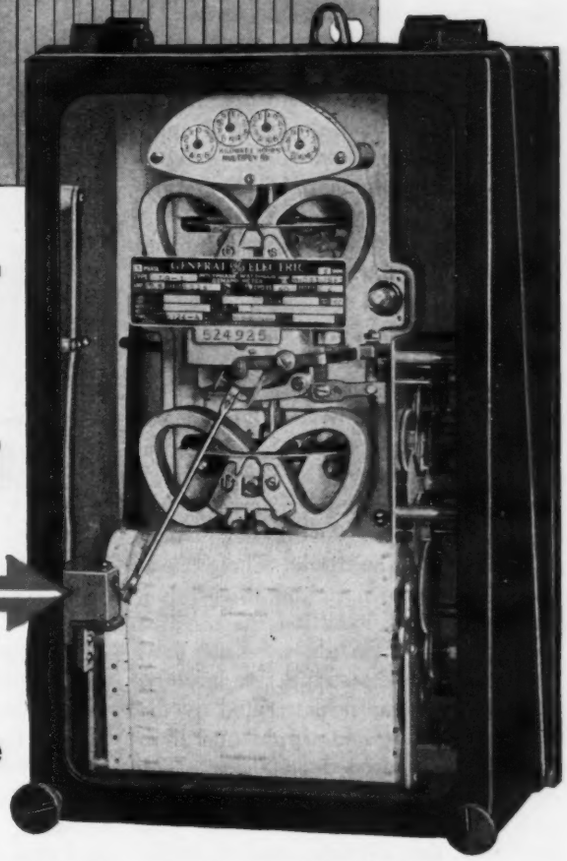
Powered with a.c. and d.c.

The main operating unit is a 2,300-volt General Electric Company synchronous motor of 1,000-hp. rating. This drives a 450-kw., 500-volt generator to operate the hoist motors, a 220-kw., 500-volt generator to operate the swing motors, a 100-kw., 250-volt generator to operate the crowd motor and a 35-kw. exciter. Hoisting is done with two 250-hp. d.c. motors, swinging by two 125-hp. d.c. motors, and crowding by a 125-hp. d.c. motor. With the exception of the five motors just mentioned, the rest of the equipment is a.c. On the lower deck of the shovel is a bank of three 50-kva. transformers to provide 440-volt a.c. power, while on the upper deck there is a bank of three 37½-kva. transformers also for 440-volt power. To furnish lighting service there is a 7½-kva.



★ ★ ★ A NEW Simplified Inking System

Makes This Demand Meter Easier to Service



TYPE DG-1, *recording watthour-demand meter*

THE new simplified inking system, now a part of the DG-1 recording watthour-demand meter, has been called "the finishing touch to an outstanding design." It is unaffected by the changes in temperature and atmospheric conditions normally encountered, and it is very easy to service.

Gives Indisputable Record

The record, in ink, is clear and clean, and at the end of each line there is a hook, or quirk, which definitely indicates the exact value of the demand; and the chart advances continuously.

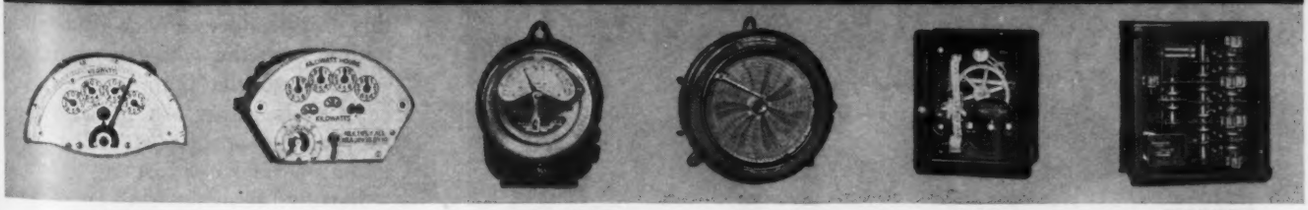
Other Features

Combination of famous I-20 watthour-meter elements with substantial, yet simple, demand mechanism. Positive and instantaneous resetting operation. Telechron timing.

What Do You Require of a Demand Meter?

Do you need to know only the peak of the month? Or must you know how and when the peaks occurred and have a definite record of the demands? Or do you need more comprehensive information—as, for example, totalized demand? Any G-E meter specialist can give you a practical solution, based on the use of proved equipment. Ask him, or write General Electric Company, Schenectady, N. Y.

TO GIVE YOU THE FACTS YOU NEED



TYPE M-20 *watthour-demand register*

TYPE M-21 *watthour-demand register (cumulative)*

TYPE M-16 *contact-operated—indicating*

TYPE G-9 *contact-operated—graphic*

TYPE PD-5 *contact-operated—printing*

TYPE DT-3 *for totalizing*

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GENERAL ELECTRIC

transformer on the lower deck and a 5-kva. unit on the upper deck.

For motive purposes each caterpillar is equipped with a 75-hp., 440-volt submarine type motor. Four 7½-hp. motors are used to operate the hydraulic leveling apparatus when the shovel moves to a new location. In addition to the motors above mentioned there are about fifteen others installed on the shovel to operate the steering mechanism, dipper trip apparatus, cable hoist, air blowers, compressors, etc. Summarizing, the equipment consists of about 1,410 hp. in a.c. motors, 275 kva. in transformer capacity, 815 kw. in d.c. generators and 875 hp. in d.c. motors.

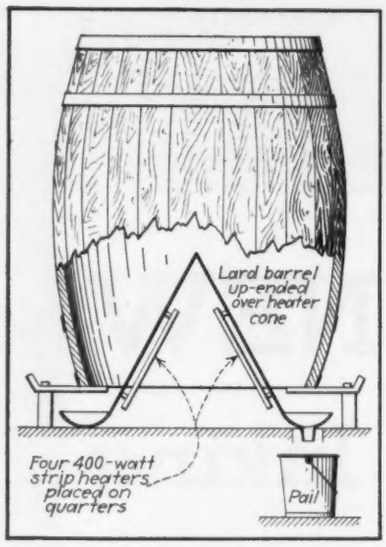
Under actual operating conditions in this mine, for a considerable period of time, this shovel has moved in excess of 31 cu.yd. of overburden per minute. After the coal has been uncovered an electric loading shovel follows in the cut of the stripper, scooping up the coal and loading it in trucks for haulage to the tipple. These truck-trailers, as shown in the illustration, are capable of handling 25 tons of coal per trip. While no tests have been made on the stripper separately, the instantaneous peak created by the stripper, loader and tipple operation has slightly exceeded 1,600 kw. The demand, as recorded by a 30-minute interval meter, is approximately 675 kw. and the average power factor about 90 per cent leading.

Among the biggest

Here is one of the world's largest shovels recently set to work in the "Bobolink" mine of the Binkley Mining Company near Seeleyville in Indiana's rich bituminous coal field.

Electricity Gets Last of the Lard

By H. R. STEVENSON
The Detroit Edison Company,
Detroit, Mich.



Electric lard melter drains barrel without scraping

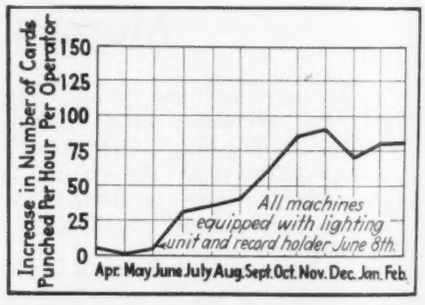
How can the baker ever get the last few pounds of lard out of the barrel? If he scrapes the inside there is grave danger that the customers will become petulant about splinters in the doughnuts. But the barrel need not be scraped. After the greater part of the lard has been scooped out the lard that clings to the inside of the barrel can be melted out. The cask is up-ended over a conical electric heater like that shown in the accompanying sketch.

These lard melters are not new. They have been in use for some time and mostly are designed for combustion heat. But they can readily be changed over to electric heat and the mere advantage of reduction of fire hazard is sufficient to justify the change. Also, in areas where gas service is not available, it is hardly possible to consider any other heat supply than electricity for this type of application.

•

Proper Lighting Boosts Card Output

Studies made with a new combination lamp and record holder designed for use in conjunction with card-punching machines indicate that by conserving the operator's energy and preventing eye strain these lamps make possible production increases of the order of 30 per cent, while cutting the number of manual errors in half.



Bettered production follows installation of individual lights on card-punching machines

The lamp used in these studies was jointly designed by the International Business Machines Corporation and General Electric Company. It consists of an opal glass bowl with opaque shade. Equipped with a 100-watt bulb, this unit produces a high-grade illumination over the entire working area. Attached to the lamp standard is a copy shelf which can be adjusted to ideal height, position and tilt for maximum operator comfort.

Results showing the increase in number of cards punched after installation of this lighting unit have been plotted on the accompanying chart and cover experience in the tabulating department of the General Electric Company.

ELECTRIFIED LAUNDRIES (Continued) (7)

Collar Finishing

Starching—Collars are starched by (1) dipping them and then removing excess starch in an extractor or (2) passing them through a machine which applies just the correct amount for proper finishing.

Ratings—⅛-½ hp. motor, belt or gear drive.

Mfrs.—3, 6, 41. (See Sheet 14.)

Dry Rooms—For drying hot-starched collars. Wood or galvanized iron cabinets equipped with chain conveyor or trucks, fans for circulating heated air, automatic unloading devices, etc.

Dry Room Ratings—Motor about 1 hp. Fan operated from conveyor drive.

Mfrs.—3, 8, 41. (See Sheet 14.)

Collar Dampening—After drying starched collars they are dampened and pressed in hand-operated press to insure uniform dampening.

Ratings—Motor ¼-1 hp.

Collar Ironing—Dampened collars ironed through machine consisting of one or two heated cylinders and a number of smaller diameter padded rolls.

Ratings—Motors up to 1 hp.

Seam Dampening—Seam next dampened to make it flexible enough to fold.

Shaping and Edging—After folding, the collars are shaped by heat and friction, very little pressure being used. After edging, the collars are pushed through hot tube shaper to produce suitable finish.

Mfrs.—3, 6, 41, 43, 46. (See Sheet 14.)

Wearing Apparel

Wearing apparel not included above is usually finished with presses or hand-irons. Particular care must be used with silks and rayons. Ironing temperatures should not exceed 300 deg. F. for certain synthetic fibers. Thus steam pressures higher than 50 lb. (298 deg. F) cannot be used.

Blankets and Curtains

Drying—Curtains and blankets are dried on frames while stretched to their proper dimensions rather than ironed. Heated air is blown into the cabinet by motor-driven fan; the air may be heated by gas, steam or electricity.

Ratings—Sizes up to 54×180 in. (horizontal type) and 75×90 in. (vertical type). Fan motor, ¼-½ hp.

Mfrs.—3, 5, 17, 21, 41. (See Sheet 14.)

Carding—After drying, blankets are passed through carders or brushers (or else hand brushed) to restore the nap. Several brushes in pairs rotate in opposite directions and the blanket passes between them. Suction keeps the brushes free of lint. Two cleaning and two brushing rolls are customary. Two-drive speeds usual, higher for cotton and lower for woolen.

Carder Ratings—For blanket widths up to 84 in. speeds up to 40 ft. per minute obtainable. Single motor for both feed and fan. About 5 hp. required, of which fan takes 3 hp. Control consists of start, stop and reset.

Mfrs.—3, 5, 17, 21, 41. (See Sheet 14.)

ELECTRIFIED LAUNDRIES (Continued) (8)

Final Assembly

Outgoing laundry is checked and bundled by packaging or final assembly department. See Sheet 11 for identification technique. Tracing missing articles is also facilitated by systematic adherence to well-planned schedule of operations.

Auxiliary Equipment

Belt and Roller Conveyors—For interdepartmental transportation of goods: Save floor space, reduce noise and labor of handling, avoid congestion by trucks, speed production, operate with minimum supervision, simplify plant schedule. Classified according to width of belt and length of carry. No motors required for roller conveyors.

Ratings—Motor (squirrel cage) ½-1 hp., usually adequate.

Mfrs.—13, 14, 26, 28, 34. (See Sheet 14.)

Monorail Conveyors—Of particular value with unloading type washers and retractors. Flexible arrangement an advantage. Classified by lifting capacity, hoisting speed and type of trolley (2, 4, or 8-wheel). Motorized trolley not essential as load of one ton can be moved by force of about 14 lb. Separate motors usual where both hoist and trolley are powered. High-torque, totally enclosed motors (with brake for lifting). Trolley motor usually about half the horsepower of the hoist motor. Trolley speed about 175 ft. per minute.

$$\text{H.P.} = \frac{\text{Load (lb.)} \times \text{hoisting speed (ft. per min.)}}{2{,}300}$$

Mfrs.—4, 20 (See Sheet 14.)

Electric Control Panels—Necessary for economical operation of groups of washers, tractors and tumblers. Where groups of individual motors operate the equipment, provision should be made to insure that no two machines start or reverse simultaneously (otherwise heavy peak demands may be created). Usually consists of (1) rotating drum switches driven at constant speed by pilot motors, (2) overload and low-voltage protective devices, (3) interlocking means to prevent starting of machines while doors are open, (4) automatic door spotting (or else an inching button).

Mfrs.—3, 10, 12, 37, 41, 43, 45. (See Sheet 14.)

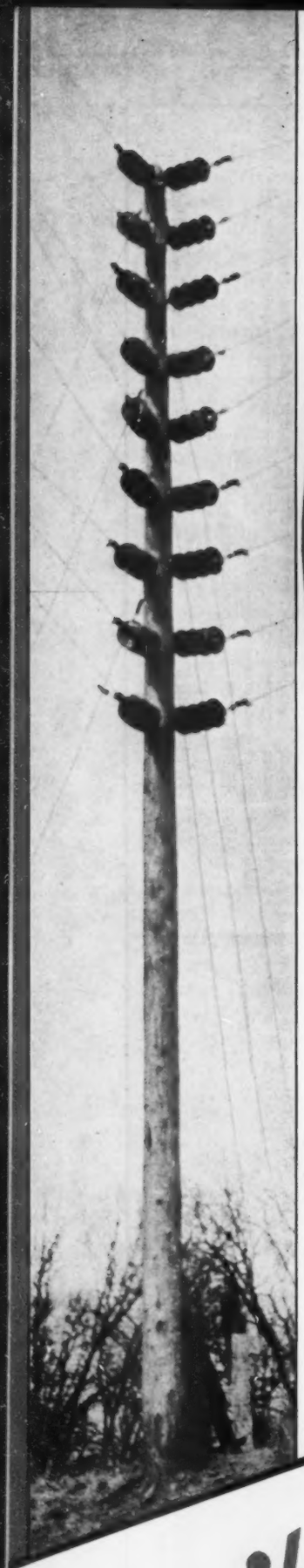
Water Treatment

Water for laundry use should be soft or else softened. Salts of calcium and magnesium are generally found in natural and spring water. These and other compounds (iron, manganese, aluminum) react with soap to render it partially ineffective as a detergent (cleansing agent for removal of soil) and to form compounds which in some cases are gummy and difficult to remove from the clothes. Moreover, repeated washing in hard water builds up a deposit of lime soap which coats the fibers, making the cloth stiff, gray or yellow and non-absorbent of water.

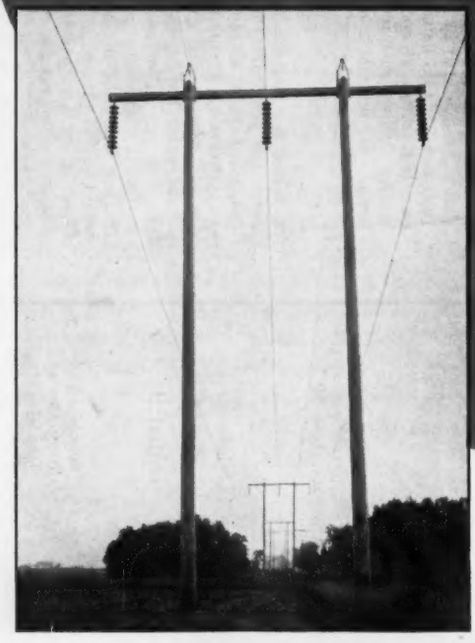
Two methods are used to remove materials that make the water hard: (1) zeolite; (2) lime soda ash; the latter is not commonly used in laundries because it requires careful control of the proportions of materials used. Zeolites are natural or synthetic compounds of sodium and potassium. Hard water passed through a granular zeolite exchanges its calcium and magnesium for the sodium and potassium in the zeolite. The depleted zeolite is regenerated (in about 40 minutes) by means of a strong solution of common salt. Zeolite treatment is not effective on water with high sodium content.

A zeolite water softener consists of a tank containing a bed of granular zeolite supported by layers of graded gravel over a strainer system. Auxiliary equipment: Water regulator, meters, automatic valves, motor-driven brine pumps, hydraulic brine injectors. Rated in gallons per minute capacity.

Mfrs.—15, 18, 19, 31, 35. (See Sheet 14.)



CHECK THESE 7 FACTORS WHEN BUYING POLES



NOTE THESE EXCLUSIVE QUALITY FEATURES OF WESTERN RED CEDAR—

- Western Red Cedar Poles are straight, strong, rigid, yet light in weight.
- Their large heartwood, preserved by nature, is highly resistant to decay and insect damage.
- Western Red Cedar combines, in one wood, more basic power line pole properties than found in any other pole timber.
- The natural preservative of Cedar is permanent . . cannot be varied, and is constant and effective from the top to the bottom of the pole.
- Additional gains can be added and holes drilled anytime after erection for joint use or for installation of additional equipment without endangering the life of the pole.

Specify **WESTERN RED**

For Low Cost Power Line

1. Cost to build

Western Red Cedar is the lightest of high-strength power-line pole woods. Light weight reduces trucking and line construction costs from start to finish.

2. Number of poles needed per mile

The great strength and stiffness of Western Red Cedar adapts it to the longest spans and the heaviest line loads.

3. Stability of the power line

Western Red Cedar pole lines stand up under adverse conditions. Realignment costs and service interruptions are reduced to a minimum.

4. Adaptability to line changes

New gains can be cut, new bolt holes bored for additional line equipment after line is built without endangering the life of Western Red Cedar poles.

5. Maintenance and inspection requirements

Incised butt-treated Western Red Cedar poles with their natural resistance to decay, require minimum inspection and maintenance.

6. Insulating value of poles

The high dielectric strength of air-seasoned Western Red Cedar reduces outages and guards against leakage from faulty equipment.

7. Appearance of poles

The natural color of Western Red Cedar poles promotes public good will. They need neither paint nor stain.

The vast forests of Western Red Cedar assure a continuous, ample supply to meet the full requirements of the utilities.

ESTERN RED & NORTHERN
HITE CEDAR ASSOCIATION
Metropolitan Bank Building
inneapolis Minnesota

CEDAR POLES

Construction and Maintenance

NEW ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Faults by Quick Graphics in Neutral

By RAYMOND C. R. SCHULZE
Assistant Engineer Transmission, Public Service Electric & Gas Company, Newark, N. J.

Two recent articles in ELECTRICAL WORLD* treated the location of line faults. Our method simply utilizes the readings of the high-speed graphic ammeters in the transformer neutral connections. These readings are the zero sequence amperes supplied to the fault by the several transformer banks. These amperes are converted into per cent figures before application to the chart, in order to eliminate the effect of fault resistance.

Since the zero sequence currents only are used, the only impedances that need be considered are the zero sequence impedances of the system in question; the amount of generating capacity in service at the time of the fault has no effect on the use of the chart. This simplifies the calculations and increases the accuracy of the method. The major difficulty in the use of the method is getting accurate current values. In some cases the high-speed trip does not work—at least no current value is reported—sometimes the overswing of the pointer will give an incorrect reading, and in other cases the current will be cut off before the pointer has reached its final value. This last case can be found by checking the slope of the trace of the pointer *across* the chart, with the slopes of traces made on a sample record from a meter of the same type.

One 220-kv. line is about 76 miles long; the other, including a tap, is roughly 112 miles long. During a period of slightly more than two years the fault location chart indication was within 5 miles of a discovered fault in 50 per cent of the cases; in 25 per cent of the cases no fault was found, and in the remaining 25 per cent of the cases the results were valueless for a variety of reasons.

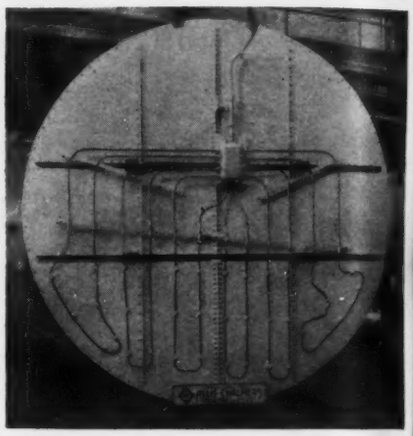
*July 20, 1935 (page 23), and October 26, 1935 (page 25).

•

Heaters Keep Roller Gates Rolling

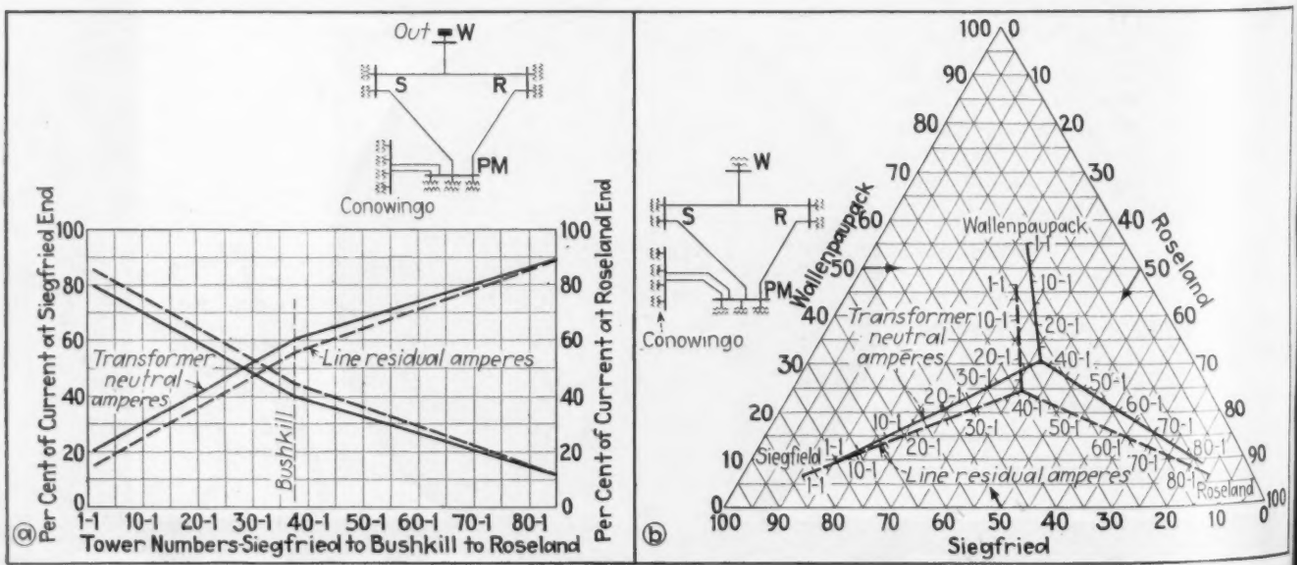
Ice firmly frozen around a partially submerged roller gate at the top of a spillway pretty well puts that gate out of business. Therefore the roller gates on the dams now being constructed by army engineers in the upper Mississippi are equipped with electric heat so they will be operable in the winter as well as in the summer. The accompanying picture, taken in the shop of the Allis-Chalmers Manufacturing Company, shows how the heating units are applied to the drum ends of the six gates at Dam No. 5 near Fountain City, Wis.

The chrome-nickel heater element is

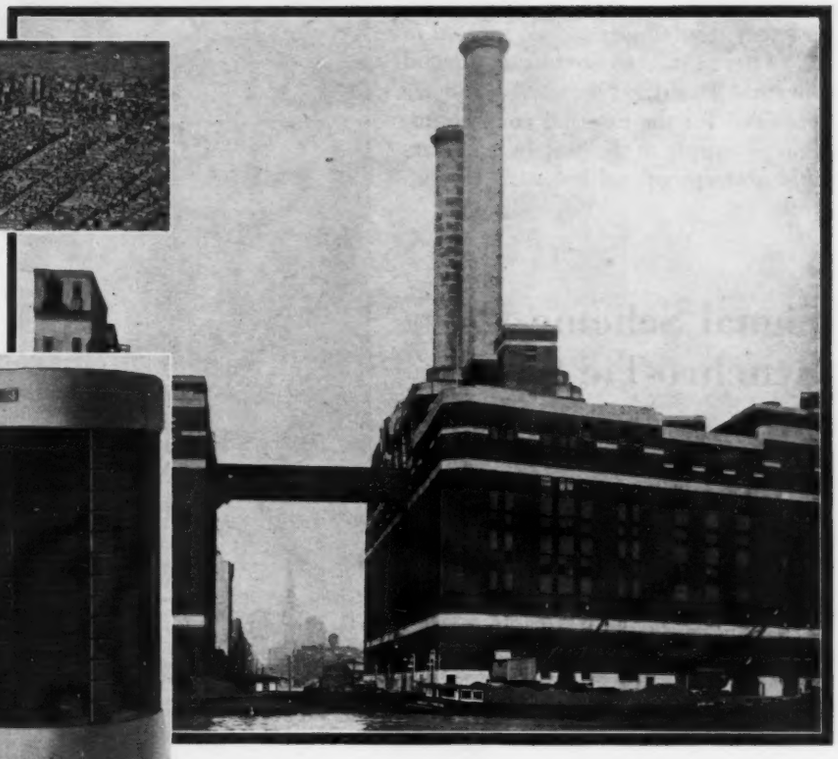


Heater for non-freeze roller gate

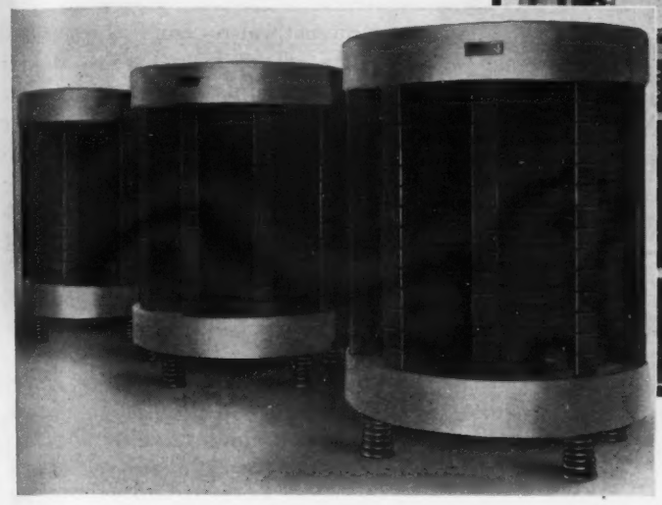
Each roller drum is 68 ft. long and weighs 200,000 lb. The over-all height of drum and apron—that is, diameter of drum plus flare of apron—is 20 ft. The heaters—3 kw., three phase, 440 volts—are of sufficient rating to maintain the recesses in the piers at the ends of the drums free of air at a temperature minus 40 deg. F. They are designed to withstand 10 per cent overvoltage in continuous operation.



Charts locate faults by tower numbers
(a) Chart for two-ended line. (b) Chart for three-ended line



East River Station of
the Consolidated Edison Co.



FOR THE MOST POSITIVE KIND OF PROTECTION AGAINST SHORT CIRCUIT DAMAGE

SOME TYPICAL USERS

Northwestern Electric Co.
Southern California Edison Co.
Commonwealth Edison Co.
City of Seattle
Detroit Edison Co.
Tennessee Elec. Power Co.
New York Power & Light Co.
Houston Power & Lighting Co.
Union Gas & Electric Co.
Northern States Power Co.
City of Tacoma
Syracuse Lighting Co.
Philadelphia Electric Co.

In Manhattan, as in many other Metropolitan areas, Murray Low Loss Reactors are protecting important primary distribution systems.

For over 25 years these current limiting reactors have been favorably known as providing a maximum in short circuit protection.

Murray Reactors are supplied for all kinds of services. Dry type reactors for line voltages up to 33 K.V. for indoor or outdoor installation—as large as 5,000 amperes—as small as .4 K.V.A.

Our engineers welcome consultation. Write for interesting 32-page booklet.

METROPOLITAN DEVICE CORPORATION
Brooklyn, New York

MURRAY CURRENT LIMITING REACTORS

embedded in a granule mineral refractory insulating material incased in a watertight, non-oxidizing metal sheath. Watertight terminal boxes are provided for the external connections. Energy supply to the heaters is by flexible waterproof cables with take-up reels.

•

Signal Scheme Uses Synchro-Tie System

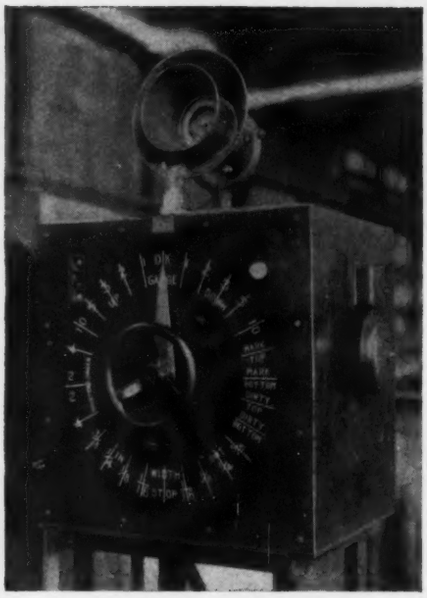
An ingenious signaling system which utilizes the synchro-tie principle is being used for communication between inspector and operator in the new 79-in. continuous hot strip mill of the Youngstown Sheet & Tube Company at Campbell, Ohio. With this system, a Westinghouse development, the inspector can report deviation from accepted strip quality so that necessary corrections may be made by the operator.

Identical transmitters are located at the coiler and piler, since the inspector will be at one or the other location, depending on whether the strip is being coiled or cut into short lengths and piled. The receiver is located at the operator's station and is connected with the two transmitters so that a signal from either will be recorded by the two others.

On the front of each station is a dial, identically marked, and a single hand. The synchro-tie so interconnects the stations that movement of the pointer at any station will cause the two others to assume corresponding positions. Provisions are made so the units cannot be energized unless they are all in the same phase position. This insures the units being synchronized and also avoids the possibility of any unit running away. All three units have lights to indicate when the system is energized and ready for use.

Inspector signals operator

When in operation, for example, the inspector might find the strip coming through 0.002 in. over the correct gage. He moves the pointer to his transmitter to the point marked "Down 2." The pointer on the receiver at the mill immediately assumes the same position, and a gong sounds. The position of the receiver pointer tells him to reduce the thickness of the sheet by 0.002 in. Having made this correction, the operator moves the receiver pointer back to the original or O.K.



Movement of the pointer on this board tells the strip mill operator when the inspector requires a correction and what that correction must be

position. This shuts off the gong and causes the transmitter pointer to return to the original position. Thus, the inspector is notified that his signal has been received and the apparatus is ready for the next signal.

•

Arc Welding Avoids Casting Huge Press

Revolutionary in design, a 500-ton capacity steel press brake, said to be one of the largest of its type ever manufactured, capable of bending materials 16 ft. long, and fabricated entirely by arc welding, has recently been constructed by the Boom Boiler & Welding Company, Cleveland, Ohio. The new brake pulls two leaves together instead of merely pushing one leaf down. This eliminates approximately 30 per cent in material and permits easy adjustment for bending by raising or lowering the bottom leaf, which is moved by worm drive controlled by a switch that is mounted on the front of the machine.

Different, also, from conventional practice is the fact that all driving mechanism, adjustment shafts, etc., are below floor level, leaving the entire top clear and eliminating danger resulting from possible overhead breakage. The new brake is 24 ft. 2 in. extreme length, 16 ft. 1 in. long between housings, 7 ft. 1 in. wide, 9 ft. 11 in. extreme height and 6 ft. 9 in. high above the floor. The weight is 61 tons.

Construction is entirely of steel, arc welded. Not a single casting is used. Providing maximum rigidity per minimum pound of weight, arc-welded steel construction permitted 30 days' saving in time and $2,200 in cost through elimination of patterns and pattern drawings. Machining costs were said to be $1,500 less than would be the case with castings. Power for operating the brake is furnished by a 30-hp. electric motor in conjunction with a 2-ton flywheel and transmitted by V-belts to gears and shafting. Operation is two-speed, four or twenty strokes per minute.

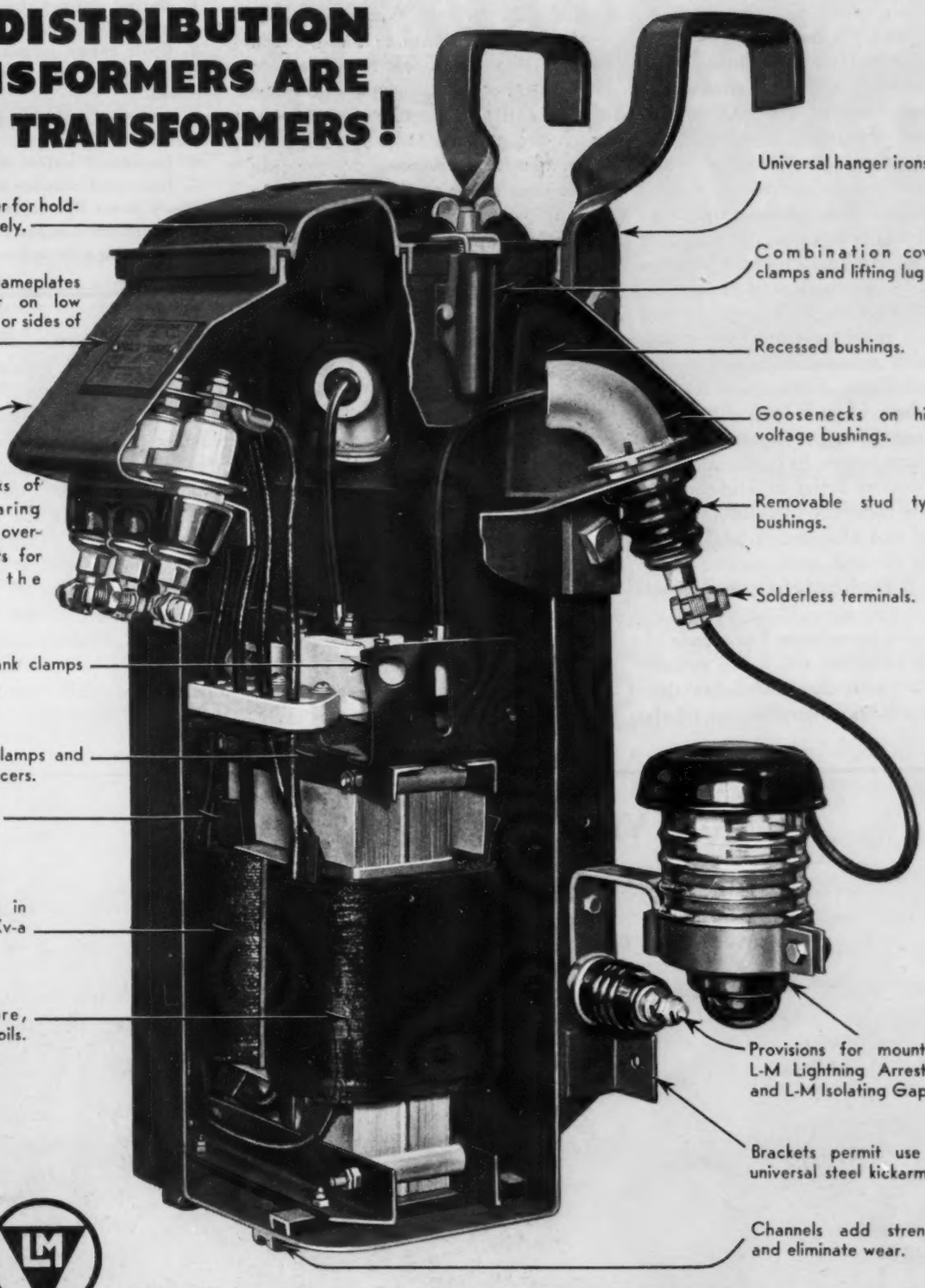
Lincoln Electric Company

Titan made possible by arc welding

According to the manufacturer, the building of a press brake so large as this would not be practical with cast-iron construction. To obtain equal rigidity in ribs and flanges with cast iron weight would be increased by more than 100 per cent.

look into it !

L-M DISTRIBUTION TRANSFORMERS ARE GOOD TRANSFORMERS!


Seat in cast cover for holding gasket securely.
Stainless steel nameplates mounted either on low voltage pockets or sides of tanks.
All-welded tanks of copper-bearing sheet steel with overhanging pockets for protection to the bushings.
Combination tank clamps and lifting eyes.
Rugged core clamps and core clamp spacers.
Extra insulation.
Lo-Hi-Lo coils in the smaller Kv-a ratings.
Rectangular core, form wound coils.
Universal hanger irons.
Combination cover clamps and lifting lugs.
Recessed bushings.
Goosenecks on high voltage bushings.
Removable stud type bushings.
Solderless terminals.
Provisions for mounting L-M Lightning Arresters and L-M Isolating Gaps.
Brackets permit use of universal steel kickarm.
Channels add strength and eliminate wear.

LINE MATERIAL CO.

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

Load Building Without Merchandising

[*Continued from page 38*]

places a competitive range in any residential consumer's home to which electric service has been connected for at least one year and to which no manufactured gas has been served for cooking for at least six months.

The power company shares not more than one-half the cost of any newspaper advertising on copy featuring electric ranges, electric water heaters, electric refrigerators, electric space heaters and announcements of electric cooking schools. The amount of newspaper advertising in which the company shares the cost is limited by agreement with the dealer and is based upon sales results obtained from past efforts with reasonable regard to future possibilities. Newspapers bill the utility's share of such costs directly to the company. Copy is approved by the company before its publication.

When dealers desire to hold cooking schools the company furnishes a home economist and absorbs, in addition, a portion of the cost, such amount being mutually agreed to before the school is held.

The dealer association has a code of fair trade practices which are strictly adhered to with the knowledge that violation might jeopardize the whole co-operative program. Policing the situation is done entirely by the co-operating dealers and there have been no serious complications since the program was initiated. Significant is the fact that electric ranges are sold at about 10 per cent *above* the manufacturers' list prices. This gives the dealer a more adequate margin and permits him to absorb the difference between the standard wiring allowance of $35 and the average wiring costs, which are around $42.50. Full-page newspaper advertisements are the rule rather than the exception. Radio time is employed to good advantage in promoting appliance sales by the dealers. During 1935 there were both newspaper and radio cooking schools held at various points throughout the territory.

Why the plan works

Sierra Pacific's co-operative program incorporates the best features of a variety of successful plans used in different parts of the country modified to fit local conditions. It works because it has wholehearted executive support and close personal contact with each participating dealer. It is based on mutual self-interest and respect for the rights of all. Desire on the part of the dealers to continue to merit and receive promotional assistance from the power company causes them to operate ethically and maintain a high standard of goods and services. The mechanics of the plan are flexible and have been and will continue to be changed as conditions warrant. The plan embodies a definite division of responsibility, the utility devoting itself to providing the best and most intimate type of public service to insure satisfied electrical consumers and the dealers devoting their energies toward greater domestic electrification. Acceptance of these responsibilities has resulted in a prosperous electrical industry and a public receptive to greater and greater electrical convenience.

What Sierra Pacific's Load-Building Plan Has Accomplished

In three years time the plan has:

1. Raised annual domestic consumption to 1,028 kw.-hr.

2. Built range saturation of 42 per cent; a refrigerator saturation of 44 per cent.

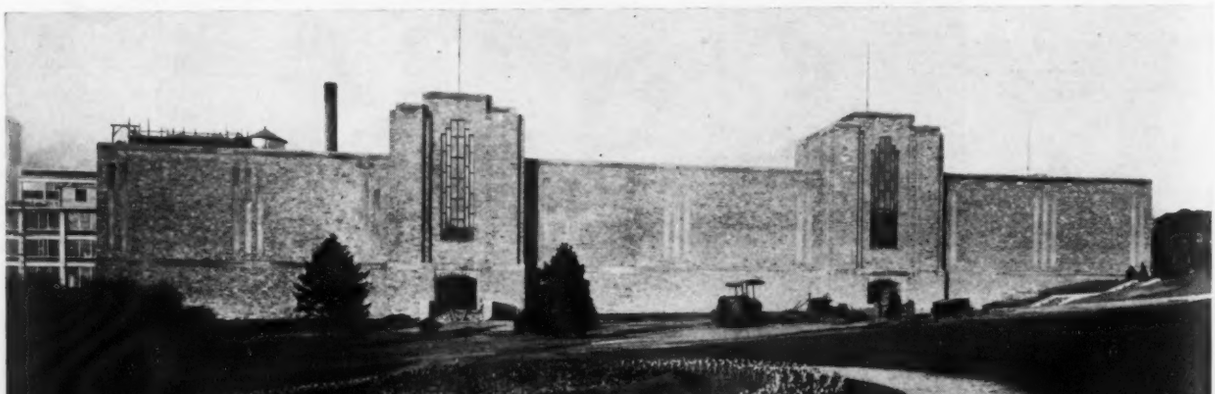
3. Lowered merchandising costs of the utility 50 per cent.

4. Improved public relations.

5. Increased number of dealers in the territory from five to twenty-six.

6. Maintained gross revenue at peak figure despite rate reductions.

New View of Windowless Building



Electrical World Photo

South elevation of windowless building at Hershey, Pa., as it appeared two weeks ago. Front half of building is now occupied by business offices. Workmen are shown at west end of roof preparing rear half of building for storage and printing departments.

New Meter Assembly Catches Transformer Loads

[*Continued from page 41*]

the primary lead. The scale of a thermal meter being non-uniform and contracted greatly below 30 per cent of full scale, it is necessary to have a meter with an intermediate ratio of 40:1 and 80:1 if greater accuracy is desired. All the ratios might have been combined in one instrument, but the additional complexity and expense did not seem to justify it, since for the few cases where the odd ratios are necessary a separate meter can be used.

The current transformer core was made as small in size as possible in order to reduce the weight. This permitted its use without any support other than the conductor, usually the loop in the secondary leads. The maximum outside diameter of conductors over which it can be used is 1¼ in. By having a short magnetic circuit and very short leads between the current transformer secondary and the meter a more nearly accurate 20:1 ratio can be secured than is ordinarily possible. While the meter and transformer are not insulated, except for one side of the secondary winding, it may be used on live conductors provided proper precautions are taken in handling and securing it in place. During the two years that the oldest of these meters have been in use they have proved entirely satisfactory and have saved considerable labor over other methods of transformer measuring.

•

University Offers Broader Course

Expansion of the curriculum for undergraduate students in electrical engineering is announced by the University of Pennsylvania. This, according to Dr. Harold H. Pender, dean of the Moore School of Electrical Engineering, is a reflection of the varied character of the work now performed by graduate engineers.

The plan, to be inaugurated next fall, offers students two points: (1) "Research and development," which prepares them for such technical tasks and research and development with either manufacturers or public utilities and for teaching. (2) "Industrial," which is intended to provide the groundwork for less technical positions, such as sales engineers, construction engineers and general purpose engineers in the public utility or manufacturing companies.

Reduced prices on Westinghouse MAZDA LAMPS make better light cheaper

● Large size Westinghouse Mazda Lamps are now offered at the lowest prices in history.

Reductions average 20% on the most popular sized lamps for selling and manufacturing, and for sight-saving in the home. Now, more than ever, everyone can afford Better Light—Better Sight.

New prices effective May 1, 1936

WATTS	OLD PRICE	NEW PRICE
150 clear	$ .40	$ .25
200 clear	.55	.45
300 clear	.90	.75
500 clear	1.55	1.40
DAYLIGHT		
150 clear	$ .65	$ .50
200 clear	.90	.80
300 clear	1.35	1.20
500 clear	2.30	2.15

Prices on comparable types of inside frosted lamps and white bowl lamps have been reduced proportionately.

THREE-LITE LAMP

100-200-300 $1.00 $ .80

WESTINGHOUSE GOLDEN JUBILEE

BUILDING UP THE LOAD

New ideas and practices in selling electrical equipment and service to industrial, commercial and domestic customers

Dental Laboratory Adds 7 Kw. Load

By W. R. REED
Commercial Engineer
Idaho Power Company, Twin Falls

Engineers of the Idaho Power Company pay frequent visits to customers to insure their satisfaction with the service. Upon such a call at the Jackman Dental Laboratories, Twin Falls, it was found that two small electric furnaces were being operated on the lighting rate rather than on the commercial cooking rate, to which the customer would be entitled had he desired to make the necessary changes in wiring necessary to connect up with the latter service. The customer, however, preferred to remain on the higher schedule rather than incur the extra wiring costs.

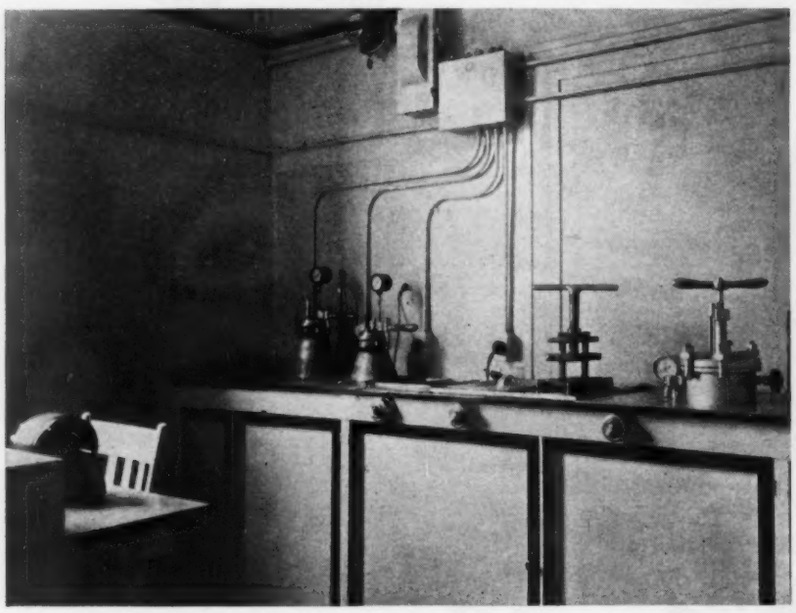
Upon studying the laboratory installation for additional applications of electricity it was found that two steam vulcanizers and two oil bath vulcanizers were being heated by gasoline from burners improvised from camp stoves. Obviously if these units could be converted to electricity the cleanliness, convenience and lowered cost would more than justify the added wiring costs.

Operating factors of the two steam vulcanizers made it necessary to bring the temperature to 320 deg. F. in 25 minutes and maintain this value within 10 deg. plus or minus. Changes of temperature greater than 15 degrees would have a deleterious effect upon the material being treated. The oil bath vulcanizers were not as critical, the main requirement being rapid heating to the desired temperature.

For the former devices, it was calculated that a 1,200-watt, high-speed heating unit would be required; for the oil bath vulcanizers, 2,100-watt units were recommended. While the customer was skeptical as to the costs of a completely electrified laboratory, a threatened raise in insurance rates due to his use of gasoline in the building led to his decision to convert to electricity. Wiring costs again threatened the sale, but, by rearranging the laboratory apparatus to concentrate all of the electric equipment on one side of the room, and thus eliminating long conduit runs, costs were made satisfactory to the customer.

Controlling the temperature within the close limits was a problem not easily solved, largely because of bottled gas competition which entered into the transaction at this point. A "Flamo" installation which would accomplish the work at a lower installation cost and without raising the insurance rates made it necessary to eliminate all thoughts of expensive temperature regulators, which would have raised the total price of the electrical installation far beyond the competitive proposition. Temperature regulation was finally solved by adding a contact to the steam pressure gages on the vulcanizers and controlling the temperature by regulating the pressure through a range-type contactor which controlled the heating elements.

The installation has been entirely satisfactory both as to operation and costs. Gasoline cost per plate vulcanized was around 3 cents; electrical energy costs per plate are only 1½ cents. Furthermore, the customer is well pleased with the convenience, safety and cleanliness of his new installation. An excellent moral for power salesmen is contained in the customer's letter to the power company thanking the organization for its persistence in selling him on complete electrification.



Good selling by the utility converted this dental laboratory from gasoline heat to complete electrification, bringing greater convenience, safety, cleanliness and lower costs to the customer

•

Air Conditioning in Chicago Triples

To 255 air-conditioning installations in Chicago made prior to 1933, 124 were added in 1933, 238 in 1934 and 317 in 1935, making a present total of 934, according to a recent report by the Commonwealth Edison Company. In the three-year period the connected load grew from 32,614 hp. to 48,742 hp. While the number of installations increased by more than 360 per cent, the connected horsepower load rose only about 50 per cent, showing by the greater number of smaller jobs that atmosphere control is finding a rapidly widening application. This obvious deduction is

The Fibre Conduit Company • ORANGEBURG, N. Y.

Sales Agents: GENERAL ELECTRIC SUPPLY CORP. • GRAYBAR ELECTRIC CO.

Air Conditioning Installations in Chicago

as of December 31, 1935

Locations	No. Jobs	Hp.	Average Hp.
Banks	8	1,252½	157
Brokers, exchanges	9	773	86
Beauty shops	12	113	9
Churches	4	167	42
Civic buildings	1	116½	116
Clubs	4	359	90
Dance halls	4	465	116
Doctors, dentists	15	11¼	..
Drug companies	21	294½	14
Hospitals	14	91¼	6
Hotels	24	3,554	148
Industrial			
Bakery	19	304½	16
Candy	29	3,733¼	129
Printing	24	2,245½	94
Miscellaneous	28	1,260½	45
General offices and buildings	83	7,015¾	85
Private offices	171	454¼	2
Residences	69	125¾	2
Restaurants	143	3,707¾	26
Stores			
Candy	16	36	2
Clothing, dept.	28	1,850½	66
Fur	8	35	4
Shoes	15	129	9
Food	7	385¾	55
Miscellaneous	16	1,142	71
Studios	5	419¾	84
Undertakers	21	211¼	10
Theaters	136	18,799½	138
Total	934	48,942	

strengthened by the diversity of users shown in the accompanying table of installations at the end of 1935, quoted from the report.

•

Black Derbies Create Small-Town Sensation

"Our experience so far indicates that small-town people are more interested in sales promotion work than are the people in larger cities," says George A. Mills, president Kansas Electric Power Company. In the smaller places people have more time for human contacts and anything of novel appeal produces results from their awakened curiosity. The thing gets into the local newspaper, and that helps. To show how the small community reacts to business enterprises, here are quotations from a story of 13½ column inches in the Bonner Springs *Chieftain*:

Boys in Derbies Lignt the City
By Demonstrating Proper Lighting
Make City Light Conscior

To prove their point that proper lighting is far cheaper than permanent poor sight, the Kansas Electric Power Company has organized two crews, operating on their various properties. Two of these boys, identified by their black derbies and their perfectly white car, have been on the Bonner Springs property since January 25. They are expected to remain at least three weeks before going to other divisions of the company.

The purpose of this work is two-fold and may appear on the face to be an earnest effort on the part of the company to sell more energy, but there is another basic reason that is far more important than the commercial value of the undertaking.

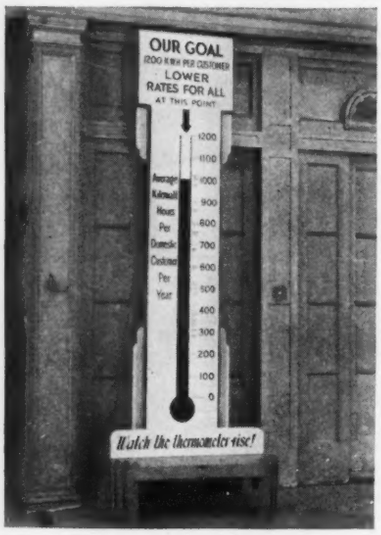
The company is attempting, and meeting with considerable success in its effort, to join the national movement of giving better lighting in the homes.

The result of the work of these engineers is gradually being brought home to the people. The home folk are beginning to realize that the home is the proper place for good illumination.

G. H. Thompson, in charge of the work here, is assisted by J. H. Reeves and Russell Gates, local commercial manager. Thompson states that they plan to go into as many homes as possible, and in nearly every case their advice is met with an interested reception and their efforts have resulted in the sale of more than 50 complete units, meeting the specifications so rigidly set by the I.E.S.

•

Graphs Lower Rates for Larger Use



Back in 1922 the average domestic customer of the Hartford Electric Light Company used 286 kw.-hr. per year and had little conception of how his rates would decrease through additional consumption of energy. Since then promotional rates have popularized the service to the point where the average consumption is now close to 1,000 kw.-hr. per residential customer, with corresponding reductions in rates and in average prices of energy. The company has had much to say about this in newspaper advertising and in other ways, but only recently set up a residential bogie thermometer in its main offices to stress its progress toward the 1,200-kw.-hr. goal, at which point rates will be established on a still lower basis, comparable to present fully electrified home service costs on the system.

•

Energy Usage of the Range

By R. W. WINSBOROUGH
Southwestern Gas & Electric Company
Shreveport, La.

In November, 1934, the Southwestern Gas & Electric Company placed 40 ranges on trial in the town of Texarkana. The first full month's billing after the installations was in January, 1935. Therefore, January, 1935, may be compared to January, 1934, and the difference in usage for these two months will indicate the value of the range plus the value of any gravity additions between January, 1934, and January, 1935.

For January, 1935, 28 bills were tabulated in comparison with January, 1934. The average increased kilowatt-hour per customer was 161. In the month of February bills from 30 of these customers revealed that the average increased kilowatt-hour per customer was 155. These figures are shown in the accompanying table. Discounting them for normal load increase, aside from range usage, it is felt that these data support the conservative figure of 125 kw.-hr. per month which is used by the company for estimating the annual revenue added by the sale of an electric range.

Table of Increased Energy Use From Electric Ranges

Customer	Kilowatt-Hours Jan., 1933	Jan., 1934	Inc.	Kilowatt-Hours Feb., 1933	Feb., 1934	Inc.
1	347	641	294	279	569	290
2	191	454	263	176	498	322
3	172	558	386	85	333	248
4	70	261	191	110	316	206
5	83	81	—2	95	173	78
6	60	226	166	80	186	106
7	40	167	127	90	191	101
8	49	170	121	135	429	294
9	113	312	199	78	175	97
10	119	318	199	72	236	164
11	94	164	70	61	240	179
12	91	297	206	41	168	127
13	43	216	173	92	206	114
14	45	176	131	63	60	—3
15	....	....	....	72	222	150
16	108	189	81	47	160	113
17	57	197	140	152	557	405
18	143	458	315	109	149	40
19	86	199	113	53	152	99
20	89	251	162	47	233	186
21	49	114	65	67	171	104
22	....	....	....	49	251	202
23	53	130	77	50	243	193
24	51	249	198	80	250	170
25	112	274	162	57	214	157
26	59	191	132	47	118	71
27	85	213	128	67	154	87
28	93	244	151	88	226	138
29	118	239	121	101	203	102
30	103	239	136	89	208	119
Totals	2,723	7,228	4,505	2,632	7,291	4,659
Aver.	97.3	258.3	161	88	243	155

REAL PROTECTION *is* MORE *than Skin deep*

The bright lad who got off, "beauty is only skin deep" unloaded a mouthful of real horse sense. In his quaint way he suggested that essential qualities—or the lack of them—may be concealed beneath the outward physical appearance.

It's good advice, too, whether you are considering peaches, a new car, oranges, women—or *wire!* One wire may look pretty much like another, but if it is to be exposed to heat, moisture, oil, grease, acids, fumes or fire hazard, which is the best for your purpose? The answer lies under the "skin" — in the materials used in the insulation and the way it is processed over the conductor.

Asbestos is the material we use. Exclusive processing methods convert it into an impervious wall of insulation highly resistant to the deteriorating agents mentioned. It's a *real protection* against wire failure. Send for our catalog which describes many of our fifty different constructions. Send for samples if you want to look beneath the "skin."

Rockbestos Products Corporation, 814 Nicoll St., New Haven, Conn.

This is a Rockbestos 600 Volt A.V.C. Power Cable
Outer covering of tough asbestos braid
Felted asbestos insulation
Asbestos sealed high dielectric insert
Felted asbestos insulation

ROCKBESTOS A.V.C.

the wire with permanent insulation

MEN OF THE INDUSTRY

Dr. Van de Graaff Awarded Elliott Cresson Medal

Dr. Robert J. Van de Graaff, associate professor of physics at the Massachusetts Institute of Technology, has been awarded the Elliott Cresson Medal by the Franklin Institute of the State of Pennsylvania "in consideration of his development of an electrostatic generator for the production of high-voltage direct currents, through which he has made possible the extension of nuclear investigation."

Massachusetts Institute of Technology's famous electrostatic generator was designed by Dr. Van de Graaff while he was a research associate in the institute's department of physics. Following graduation from the University of Alabama and a year at the Sorbonne, he was appointed a Rhodes Scholar in 1925, and for the next four years studied at Oxford University. From 1929 until 1931, when he joined the staff of M.I.T., he carried

on advanced research as a national research fellow at Princeton University. He was appointed associate professor of physics in 1934.

It was while studying at Oxford that Dr. Van de Graaff conceived the idea of designing an electrostatic generator. Later, while at Princeton University, he built a laboratory model of the machine which developed direct current at a potential of more than 1,000,000 volts, an accomplishment which stimulated world-wide scientific interest. Out of this laboratory machine grew the designs for the huge generator, which developed direct current at more than 7,000,000 volts in its first test at the institute's Round Hill research station last year.

•

▶ PROF. SAMUEL W. DUDLEY, Strathcona professor of mechanical engineering at Yale University, has been appointed dean of the Yale School of Engineering, to succeed Robert E. Doherty, recently elected president of the Carnegie Institute of Technology. Professor Dudley has done much original work with the braking equipment on electric rolling stock and high-speed stream-lined trains.

•

Benjamin Electric Names Additional Executives

At a formal meeting of the board of directors of the Benjamin Electric Manufacturing Company, DesPlaines, Ill., additional officers were elected as follows: E. E. Bradway, Wilmette, Ill., vice-president in charge of operations; J. H. Fall, 3d, Winnetka, Ill., vice-president and general sales manager; B. G. Kodjbanoff, New York, N. Y., vice-president in charge of eastern division; Miles F. Steel, San Francisco, Calif., vice-president in charge of Pacific Coast division; C. B. Harlow, Oak Park, Ill., vice-president in charge of central division; C. F. W. Alfvin, Winnetka, Ill., secretary and assistant treasurer, and D. S. Hazen, Park Ridge, Ill., comptroller and assistant secretary.

•

▶ L. G. GALE, formerly chief electrical engineer James Wilkinson & Company, Boston, Mass., is now sales engineer for the National Electric Products Corporation, with offices at Boston.

▶ SAMUEL L. IRVING of Chester, president of James Irving & Son, Inc., woolen yarn manufacturers, has been elected a director of the Philadelphia Electric Company.

▶ W. M. PARK has been appointed to the Sauk Center, Minn., Water, Light and Power Commission, succeeding Dr. H. F. Henneman, who held the position for eighteen years.

▶ GEORGE R. TUCK has been appointed wire inspector at Needham, Mass., succeeding the late Joseph Alexander.

▶ T. WALLACE ESTES has been named manager of the Arkansas Power & Light Company at Marked Tree to succeed W. B. Avera, resigned.

▶ W. D. MATTISON has been appointed advertising manager of the General Cable Corporation with headquarters in White Plains, N. Y. Mr. Mattison has been associated with the electrical industry for many years in the wholesaling and manufacturing branches of the business. He has been with the General Cable Corporation since its inception.

W. T. Neill of Portland Made Vice-President

Will T. Neill, who was recently elected a vice-president of the Pacific Power & Light Company (April 25, page 120), brings to his new executive position an extensive knowledge of utility rate and valuation problems. For the past fifteen years he has been associated with Pacific Power & Light in charge of rates, valuations and relations with state regulatory commissions.

Having had some experience in electrical construction work prior to graduation from the University of Oregon in 1913, following the completion of his

technical education he was appointed to the engineering staff of the Public Service Commission of Oregon. He left the commission to enter private practice as a utility valuation specialist. Later he became associated with Henry L. Gray, consulting engineer, where he assisted in the preparation of rate cases and appraisals for the Pacific Power & Light Company and for the Portland Gas & Coke Company. His appointment as rate engineer of Pacific Power & Light followed in 1921.

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▶ H. G. HARPER, for many years superintendent of the Kenova (W. Va.) plant of the Appalachian Electric Power Company, has returned to that position after having served as plant superintendent at Logan since last August.

▶ ALBERT D. NORTONI, formerly judge in the St. Louis Circuit Court, was recently named by Gov. Guy B. Park to serve as a member of the Missouri State Public Service Commission. Judge Nortoni is well known in Missouri political and legal circles.

▶ J. H. GRAFT has severed his connection with the Youngstown Sheet & Tube Company to become chief electrical engineer of the Youngstown district of the Public Steel Corporation. He succeeds Frank W. Cramer. Mr. Graft has been with the Youngstown Sheet & Tube Company's electrical department for the past sixteen years and at the time of his resignation

Your Search for the Right Truck Ends Here

IN THE International line there's a truck for your job. Here, in one line of trucks, with 25 different models and a total of 70 wheelbase lengths, the needs of the truck user are met completely.

Each year increasing numbers of truck operators realize that this complete line holds the best solution to their problems. International new-truck registrations for the year 1935 over 1934 showed a gain *nearly three times as large* as that of the truck industry as a whole.

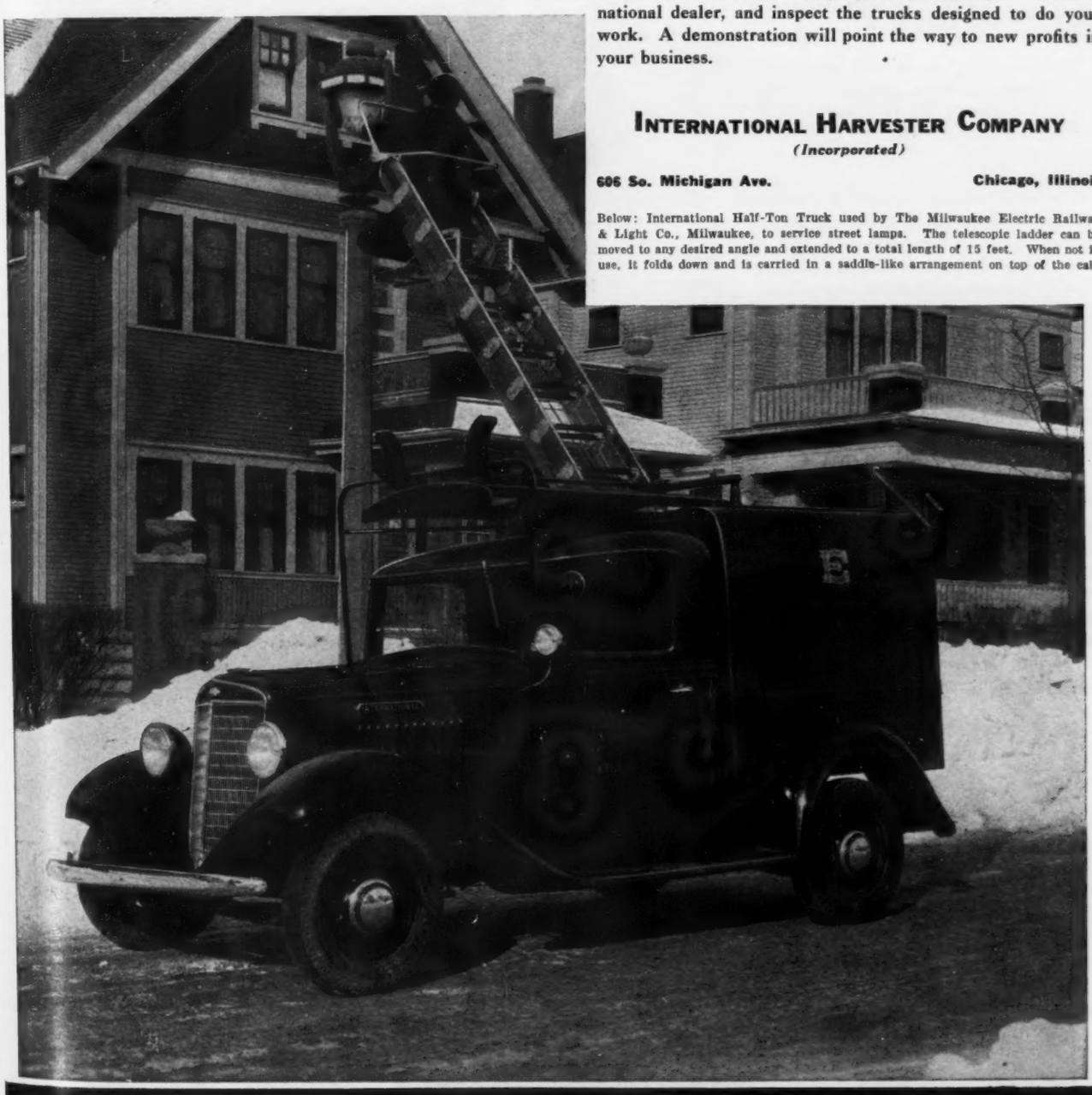
Truck operators recognize the extra value that International Harvester is able to build into every truck that bears the name. More than thirty years of perfecting *all-truck* construction means a great deal to every user.

Call on the nearest Company-owned branch, or an International dealer, and inspect the trucks designed to do your work. A demonstration will point the way to new profits in your business.

INTERNATIONAL HARVESTER COMPANY
(Incorporated)

606 So. Michigan Ave. **Chicago, Illinois**

Below: International Half-Ton Truck used by The Milwaukee Electric Railway & Light Co., Milwaukee, to service street lamps. The telescopic ladder can be moved to any desired angle and extended to a total length of 15 feet. When not in use, it folds down and is carried in a saddle-like arrangement on top of the cab.



INTERNATIONAL TRUCKS

was occupying the position of assistant superintendent. He is a graduate of the Carnegie Institute of Technology, Pittsburgh, Pa.

▶ H. H. CAKE has resigned as sales engineer of the General Electric Supply Company at Los Angeles, Calf., to become associated with J. E. Haseltine Company, Portland, Ore.

▶ JOHN F. COOKE has been appointed to direct sales of the hoist, pump and marine division of the American Engineering Company, Philadelphia, Pa.

▶ W. F. RING was elected to the board of the Lancaster County (Nebr.) Rural Power District at a recent meeting of directors. He fills a vacancy left by the death of Frank Lolte of Walton.

▶ BENJAMIN F. LIDDON will again head the Alcorn County (Miss.) Electric Power Association for the year 1936-37, having been re-elected at the recent annual meeting.

▶ C. E. PLUMMER, formerly superintendent of electrical distribution for the Turlock (Calif.) Irrigation District, is now electrical engineer for the Modesto (Calif.) Irrigation District.

▶ CHAS. E. RORABACK has been elected a director of the Torrington (Conn.) Electric Light Company to succeed the late George B. Alvord. Mr. Roraback also succeeds Mr. Alvord as a director of the Torrington Water Company.

▶ R. M. HUDGINS, formerly with the Winston-Salem force of the Duke Power Company, has been promoted to the position of manager of the Elkin district to succeed H. T. Brown, who was relieved of his duties at his own request because of ill health. Mr. Hudgins is a native of Hampton, W. Va., and a graduate of the Virginia Military Institute in electrical engineering.

Alabama Power Elects Coleman Vice-President

A. S. Coleman of Montgomery, Ala., has been elected a vice-president of the Alabama Power Company. The selection was made at the recent annual meeting of the board of directors, at which all other present officers were re-elected.

Mr. Coleman is division manager of the southern division and maintains

headquarters in Montgomery. He has occupied this position for the past twelve years.

Prominent in industrial, business, civic and social affairs of Montgomery and its trade territory, Mr. Coleman has achieved his high position with the power company step by step, starting his career in the industry as a meter tester's assistant with the old Birmingham Railway, Light & Power Company in 1911.

In 1919 Mr. Coleman went to Montgomery to become associated for nearly two years with Ray Rushton as receiver for the Montgomery Light & Traction Company. In 1921 he joined the Alabama Power Company as manager of the Gadsden district, but returned to Montgomery in 1923 as district manager.

The new vice-president is popular with the many employees of the company who showered him with congratulations as soon as the news reached them of his promotion.

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Graybar Employees Complete Long Service Record

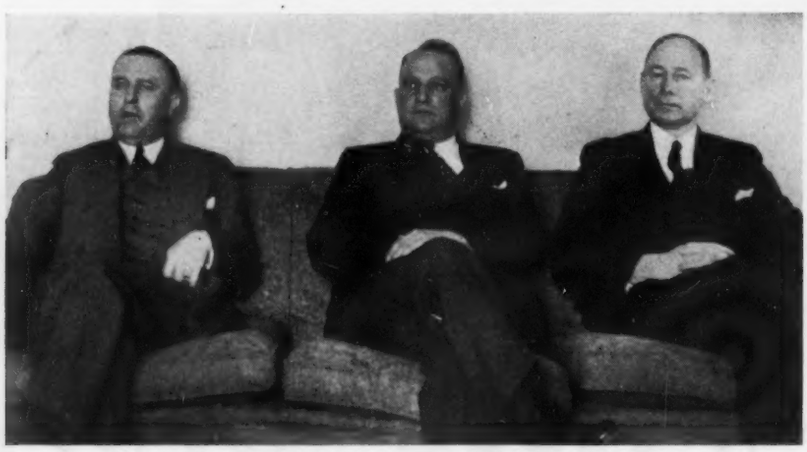
Elmer W. Shepard, treasurer of the Graybar Electric Company, completed his thirtieth year of continuous service with that company in April. Mr. Shepard started in the secretary's office in Chicago in 1906, when Graybar was part of the Western Electric Company, with the main office in Chicago. Subsequent appointments sent him to Indianapolis, Cleveland and New York for the organization, and later when the supply department of Western Electric, with which he was connected, became Graybar, Mr. Shepard was made treasurer of the new organization and appointed a director of the Graybar Management Corporation. Four other Graybar employees completed service records in April, ranging from 20 to 45 years. John T. Valenta of Chicago heads the list with 45 years of service and has the distinction of the longest service record of any Graybar employee. These years have been spent in Chicago in the sales department. Mr. Valenta is assistant supply specialist at Chicago. George W. Cramond, manager of the utilities department at Cincinnati, and Edward R. Evans, service supervisor at Buffalo, each receive the 30-year award. Daniel H. Freeman, city salesman at the Boston office, completes his twentieth year.

O. H. Leutwiler has been appointed service manager for the Graybar Electric Company, Inc., at St. Louis, Mo. Mr. Leutwiler, who has been with the company at St. Louis since 1908, has engaged in voucher and accounting work ever since he joined the staff. VAN T. PENNOYER, his predecessor, has retired after many years of service.

•

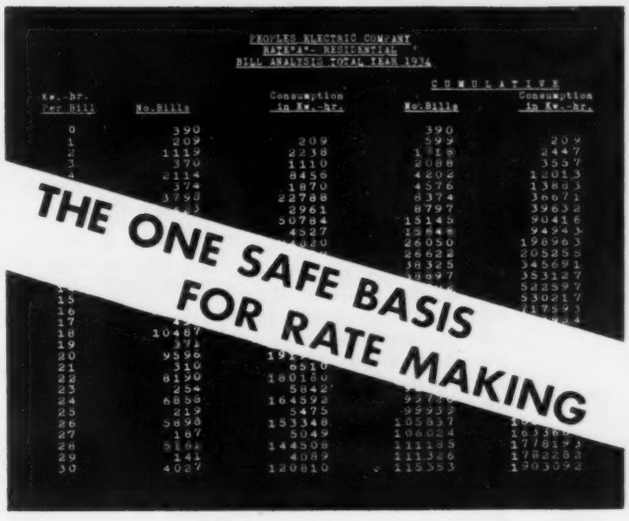
▶ RALPH W. WILEY, chief of the San Francisco Department of Electricity, was elected last week in Chicago president of the International Association of Electrical Inspectors. Entering the city's service in 1912 as underground engineer in the Department of Electricity, Mr. Wiley rose by successive stages to head the department. He has been chief electrician since 1920. Mr. Wiley is widely known as an inventor of electrical devices and invented and installed the city's traffic system of signals. San Francisco was the first city to install automatic electric stop-and-go devices.

▶ WILLIAM T. WHITE, director and general sales manager of the Horton Manufacturing Company, Fort Wayne, Ind., maker of household washing machines, has resigned. Mr. White began as a



Among those present at the recent sales convention of the Edison Electric Institute in Chicago (left to right): Ray Turnbull, General Electric; C. A. Nash, Peoples Light, and Davis DeBard, Stone & Webster.

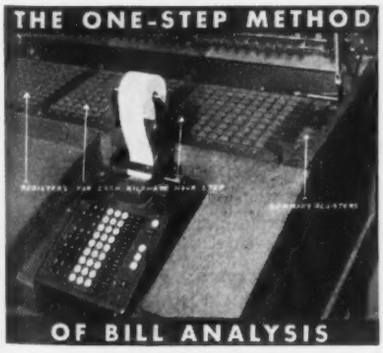
Continuous Bill Analysis at Small Monthly Cost



Bill Analysis for one rate
Revenue effect of any proposed rate may be readily determined

HAILED as the first practicable and economical means for producing reports currently, this *One-step* Method of Bill Analysis enables you to have always up-to-date figures available for rate calculations.

The simplicity of this method lies in the fact that the consumptions on monthly bills are distributed by kw.-hr. steps in a *single* operation. Tabulating is done from your custom-ary billing register without in any way interrupting your regular routine.



R. & S. Bill Frequency Analyzer: This machine we developed especially for our Public Utility Rate Service. The kw.-hrs. billed are entered on the adding machine keyboard. A tape is prepared of all items and a consumption total accumulated, which serves as a control. At the same time—by this single operation—the bill count for each kw.-hrs. step is made by the electrically controlled accumulating registers.

Our month-to-month bill frequency tables supply a new gauge on consumer response. Thus, for the first time you can appraise the result of promotional rates or other new business activities in converting unprofitable into profitable customers. The combined tables furnish a complete report of the latest year's data for consistant rate making.

To appreciate the value and economy of this new method, let us submit the cost of a complete bill analysis.

Recording & Statistical Corporation

The World's Largest Statistical Service Organization

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BOSTON PHILADELPHIA CHICAGO DETROIT OKLAHOMA CITY
MONTREAL TORONTO

DEPENDABILITY
low maintenance cost

The simplicity of operation of Lincoln Demand Meters results in dependability and low maintenance cost. In Lincoln Demand Meters, only one simple unit, comprising of a shaft and pointer and two bimetallic coils, moves—and that SLOWLY. They are free of timing mechanisms and of all rapidly moving parts.

LINCOLN
DEMAND METERS

Watt Demand and Ampere Demand meters for every requirement. Indicating or Graphic.

INDEPENDENT OF THE WATTHOUR METER

Lincoln Demand Meters operate independently of the watthour meter. They are merely connected to the same load. One type of Demand Meter for any make or type of Watthour Meter.

LINCOLN METER CO., Inc.
Springfield, Illinois

salesman for the company upon his graduation from the University of Michigan in 1924 and has been successively district manager, advertising manager, sales and advertising manager and, since 1933, general sales manager.

•

OBITUARY

W. C. Baylies

Walter C. Baylies, formerly president of the Edison Electric Illuminating Company of Boston and for many years a prominent figure in Boston business circles through his banking, railroading and manufacturing connections, died May 3, in his seventy-fourth year. Mr. Baylies, who retired as president of the Edison company about a year ago (ELECTRICAL WORLD, May 11, 1935, page 72)

was born in Taunton and graduated from Harvard in 1884.

He began his business career in railroading with the Erie, becoming assistant general freight agent in New York. In 1889 he moved to Boston and first became associated with Boston Edison as vice-president in 1891, serving for three years. He was again elected to this office in 1900. He served as president from April, 1932, to February, 1935.

•

E. C. Kimball

Edward C. Kimball, for many years an outstanding figure in the Boston Edison company's sales organization, and known throughout the industry for his activities in industrial power and load building fields, died suddenly on May 4 at the Lynn Hospital, following an attack of acute appendicitis. He was born at Brockton, Mass., in 1876, and after a short experience in dry goods wholesaling joined the Edison sales staff in 1901. For two years following the merger with the Boston Electric Light Company in 1902 he was engaged in standardizing rates, later becoming head of the complaint division. Since 1910 he has been assistant superintendent of sales. Mr. Kimball was a member of the Edison Pioneers and of the company's Gold Button Club, signalizing 20 or more years of service, and he was active in national industry affairs. His foresight in appraising fields for expanded electrical service and his analytical capacities were widely valued both inside and without the Boston organization.

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▶ GEORGE L. FISKE, Arlington, Mass., electrical engineer, died April 13, at the age of 60. Mr. Fiske was superintendent of the Clark & Mills Electric Company, Boston, for 40 years.

▶ FRANK G. C. ROGERS, who retired last winter after 30 years' service as electrical engineer of the American Can Company, Boston, Mass., died at his home in Revere, Mass., on April 29, at the age of 55.

▶ GEORGE T. NOPHSKER, purchasing agent for the Penn Central Light & Power Company, Altoona, died April 23, after a long illness. Mr. Nophsker was well known to manufacturers, dealers and operating personnel of the utility industry. He had been identified with Penn Central continuously since 1912. He was the company's first engineer and was associated with Vice-President J. E. Shute in right-of-way projects. He made the surveys for a number of the power lines in the company's area of operation. He had been purchasing agent since 1918. Mr. Nophsker was 51 years of age.

▶ F. H. RICKEMAN, general manager of Interstate Light & Power Company at Galena, Ill., died April 6, of heart disease. He had been manager of the company for 25 years and was 63 years of ago.

▶ LESTER H. NATION, assistant superintendent of the meter department, Malden (Mass.) Electric Company, died suddenly at his home in Malden on April 22. He was born in Malden 44 years ago and was educated at Wentworth Institute, joining the company in 1925.

▶ FRANK N. LESLIE, superintendent of the Chippewa Falls, Wis., plant of the Northern States Power Company as well as superintendent of the utility's meter and service department of that district, died April 8 in his sixty-fourth year. Mr. Leslie joined the utility when it was known as the Chippewa Fuel, Water Works & Light Company in 1896.

▶ PROF. BARRY MACNUTT, for many years head of the physics department at Lehigh University, and widely known in the electrical field as co-author with the late Prof. William Suddards Franklin of the Massachusetts Institute of Technology of a number of books on electricity and magnetism, died at his home in Gloucester, Mass., on April 26. He was born in Fort McHenry, Md., 58 years ago, and retired from teaching in 1927.

Bus Protection Gives Service Reliability

[*Continued from page 56*]

teresting switching operation occurred which gave at the worst momentary interruption to service to the particular station area where the trouble existed, but which in no case resulted in any extensive interruption to service.

The theoretical considerations and the practical experience with differential protection schemes outlined above seem definitely to indicate that in modern power supply systems differential protection of buses is essential. Further, the benefits to be derived are not only those most important and intangible benefits of better service and good will, but the very definite tangible benefits of decreased damage to equipment and, therefore, decreased maintenance costs. From this it seems clear, to the author at least, that no important high-tension bus or station can afford to be without it. When all theoretical considerations and extensive practical experience definitely show an adequate return from every standpoint on the cost of providing differential protection there seems to be no reason for deferring so essential a job on any bus supplying a load area of any consequence.

•

Exposition in London Maps Electrical Needs

Consumption of electric energy by the Earl's Court Exposition in London is put at more than 5,000,000 units annually for light and power and from 8,000,000 to 11,000,000 additional for heating. The plans call for air conditioning of the main building and for the heating of the large swimming pool which is a feature of the sports center to be erected.

•

French Output Rises

Production of electric energy in France last year totaled 11,060,991,000 kw.-hr. against 10,702,178,000 in 1934, according to reports for the 68 principal generating stations representing practically 95 per cent of the country's capacity.

•

Lighting Costs Studied

Street lighting costs in Rochester, N. Y., are being compared with other cities. City Manager Baker has named a committee which is to report prior to expiration of the present contract with Rochester Gas & Electric on December 31, next.

HOW MANY —— OF THESE QUESTIONS CAN YOU ANSWER?

1 What new device saves 25% to 40% of drafting time and results in far greater accuracy?

2 How can you eliminate discoloration, brittleness and bad odor from Vellum tracings?

3 Is it possible to make a pencil tracing that will reproduce approximately as well as an ink tracing—thereby eliminating the expense of ink work?

4 By what simple, inexpensive process are black line prints made directly from the tracing—without the use of a negative, and *faster* than blue prints?

5 What process is used by engineers and draftsmen when they wish to make extensive alterations on part of a tracing, *without* redrawing the entire tracing?

You'll find the answers—and a mine of other valuable information, besides—in our new, Free Book, "Ten Doors To Progress." Mail the coupon for your copy . . . There's no obligation.

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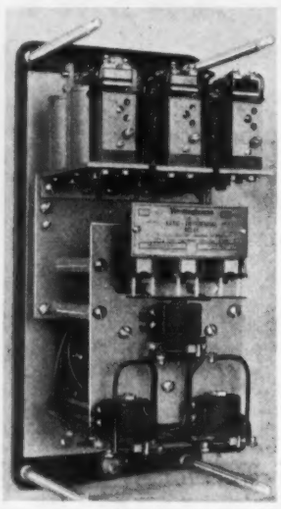
SENSITIZED PAPERS . . . REPRODUCTION PROCESSES . . .
DRAFTING ROOM EQUIPMENT . . . DRAWING MATERIAL

NEW YORK CHICAGO DETROIT BOSTON NEWARK ST. LOUIS PITTSBURGH
LOS ANGELES SAN FRANCISCO MILWAUKEE

NEW EQUIPMENT AVAILABLE

Differential Relay

To provide high-speed protection for alternating-current apparatus ratio differential relays have been developed which increase system stability limits by placing the protection of generators and transformers on the same high-speed basis now widely set for transmission lines. The operating time of one cycle reduces the chance of damage which might occur to equipment protected by slower relays. Balance beam construction is employed, with restraining and operating units magnetically identical.



Type HA; two types available for generator and transformer protection; generator unit provided with taps to operate on unbalance of 5, 10 or 20 per cent of smaller secondary current; transformer unit operates on fixed differential of 25 per cent. **Westinghouse Electric & Mfg. Co.**, E. Pittsburgh, Pa.

•

Hot Line Operating Sticks

A bell-shaped entrance on these wrench type safety sticks is said to simplify greatly retrieving operation. A fool-proof lock is provided which prevents accidental release of the clamp. The straight-grained sticks are protected with "Insulex," a waterproof covering of high dielectric strength.

Sticks may be had with or without standard hook at reverse end; lengths from 4 to 18 ft. available. **Memco Engineering & Mfg. Co.**, Long Island City, N. Y.

•

Sound Level Indicator

Data on sound and noise levels in industry can be quickly secured with a new sound level indicator recently marketed. The unit consists of a calibrated crystal type microphone, audio-frequency amplifier, calibrated attenuator, an ear-weighing network, decibel meter and crystal type headset. Sound levels are said to be measured with this instrument exactly as heard by the human ear.

Range 30-90 decibels, A.S.A. standard; designed for a.c. operation. **Industrial Apparatus Co.**, Chicago.

•

Underground Pipe Detector

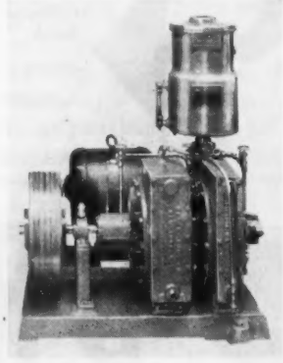
Search for distant and deeply laid underground pipes is made easier and more efficient by a new magnetic detector which is said to indicate the presence of pipes within one diameter even at depths of 7 ft. The instrument is a surveying compass with an adjustable bar magnet for reducing the control effects of the earth's magnetic field, thereby rendering the needle more susceptible to magnetic disturbances produced by a missing pipe. The bar magnet is adjustable for height and azimuth. Detector is sensitive to iron and steel pipes having any magnetic bearing. It may be used with or without electric current through the pipe.

General Electric Co., Schenectady, N. Y.

•

High-Vacuum Pump

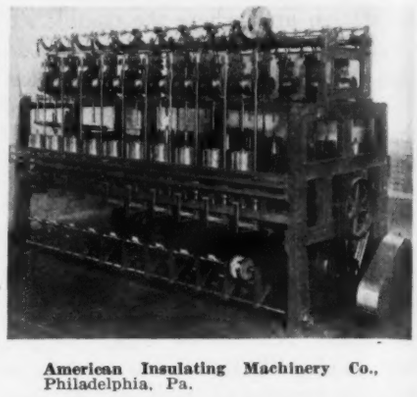
This pump for vacuum impregnation of insulating varnishes is equipped with a new type water oil separator which collects and discharges accumulated water without affecting the vacuum produced. It can be built of any required metal to resist corrosion characteristics of impregnating compounds and is constructed without valves, gears or springs to eliminate the principle source of trouble in vacuum impregnation. Two cylinders are cast integral. Thus the tendency toward leakage between stages is eliminated.



Capacities of 8, 15, 30, 55, 100 and 200 cu.ft. per minute available. **Beach-Russ Co.**, New York City

Insulating Machine

Features of simplicity, high speed, efficiency and compactness are claimed for this machine, which applies cotton, silk, paper, cellophane or cellulose acitate tape with equal facility, either single or double cover, to conductors of various types.



American Insulating Machinery Co., Philadelphia, Pa.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

AIR-CONDITIONING CABINETS—Buffalo type PC central conditioning cabinets are described in bulletin 501 of the Buffalo Forge Company, Buffalo, N. Y., which presents 14 pages of temperature charts for use in calculating air-conditioning requirements. Examples illustrating the use of the charts are given.

ELECTRIC TRUCKS AND TRACTORS — A 24-page bulletin of the Electric Storage Battery Company, in addition to illustrating the application of electric trucks and tractors in industry, also presents charts and tables that give operating characteristics of Exide ironclad batteries and data on their dimensions and ratings.

MERCURY-ARC RECTIFIERS—Illustrated bulletin No. 1174, issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., deals with the application of mercury-arc rectifiers to trolley bus service. Suitability of rectifiers for power supply to trolley bus systems is demonstrated by interesting operating and performance data.

AIR COMPRESSORS—"Unitair" two-stage, air-cooled, V-type, single-acting, stationary compressors are described in bulletin No. 88-O of the Sullivan Machinery Company, Michigan City, Ind. Full information on features and available sizes and ratings is given.

ARC WELDING—"A Guide to Lower Tooling Costs with Shielded Arc-Welded Steel Jigs and Fixtures," recently published by the Lincoln Electric Company, Cleveland, Ohio, tells how arc welding may be applied to the fabrication of jigs and fixtures, thus lowering tooling cost.

SAFETY SWITCH—The principle of the "Vacu-Break" circuit rupturing is illustrated and described in a 15-page bulletin of the Bull Dog Electric Products Company, Detroit, Mich. Features of the design are outlined and rating and dimension data is tabulated.

TRUCK AND TRAILER RESTRICTIONS—A condensation of the laws regulating the size and weights of trucks and trailers as enacted by the legislature of each state are given in a pocket-sized handbook of the Four Wheel Drive Auto Company, Clintonville, Wis.

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Dilecto is a versatile laminated plastic material with which you can do things difficult, or perhaps impossible, to accomplish with any other single material.

Dilecto is an excellent electrical insulator with dielectric strength superior to many commonly used insulating materials. *And it retains its insulating qualities even when exposed to moisture or high humidity.*

Dilecto has mechanical strength to withstand rough usage. It is light, about half the weight of aluminum. It is readily machined. It withstands many organic acids, and inorganic acids, in moderate concentration. It is insoluble in all ordinary solvents. It withstands temperatures up to 240° F.

Dilecto is used, in increasing quantities, throughout practically all industry, for a variety of purposes that range from low-power-loss radio parts to theatre decorative effects; from acid pipe and fittings to bearings for steel rolling mills; from oil-burner insulating parts to ornamental table tops.

THIS NEW CATALOG WILL BE HELPFUL

Send for a copy of the complete Dilecto catalog—it will bring you up-to-date on information and show you many applications of Dilecto in various industries.

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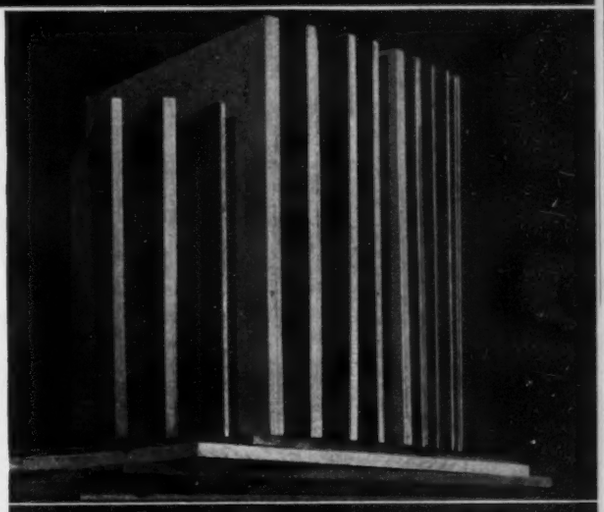
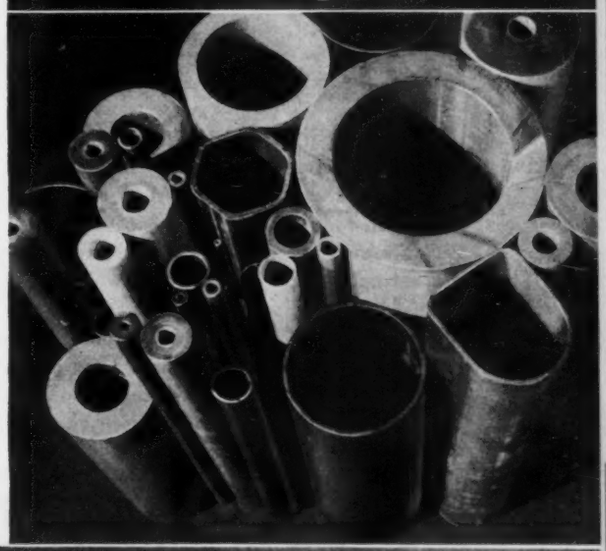


RODS

TUBES



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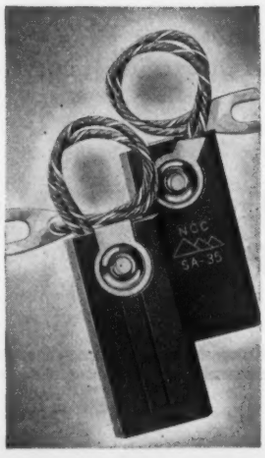


NATIONAL CARBON COMPANY, INC.
Carbon Sales Division, Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

BOOK REVIEWS

Utility Chart, 1936

By Robert A. Burrows. Published by Robert A. Burrows, First National Bank Building, Pittsburgh, Pa. Size 34x28 inches. Price, one color, $2; nine colors, $3; unfolded mailing 25 cents extra.

An extraordinary amount of information useful to utility executives, investors and others interested in the utility industry has here been compressed into a small space and presented in convenient form for quick reference. The inter-relation, capitalization and various financial data of the principal public utility holding, operating and investment companies are shown as of January 1, 1936. More than 500 companies are included. Statistics are given for about 50, the others being in general subsidiaries embraced in the corporate set-up, which is evident at a glance. These statistics include capital divided between bonds, preferred and common stocks, ratio of capital to assets, gross revenue and net income. revenue classification into electric, gas, water and other service, present voting control in subsidiaries, stock symbols, price ranges for seven years and sundry other.

●

Artificial Light and Its Application

Published by Westinghouse Lamp Company, Bloomfield, N. J. 258 pages, illustrated (8x11 zincograph). Price, 50 cents.

Intention here is by no means to qualify the reader as an illumination engineer but rather to amplify the (Westinghouse) Employee Educational Plan lectures. Caliber of treatment and contents are such that lighting salesmen and illumination dealers could very well rely on this as a handy one-volume reference book of what is available for lighting use and how its proper use can be guided. Physics of the filament and eye as well as the psychology of vision are fused with the technique of photometry and light control to lay the foundation for a discussion of adequate levels of lighting and how to attain them quantitatively and qualitatively. Tables, charts and photographs help to deal with not only space lighting but also flood, display and sign lighting. Home, farm and street lighting are accorded separate chapters.

●

Public Utility Regulation and the So-Called Sliding Scale

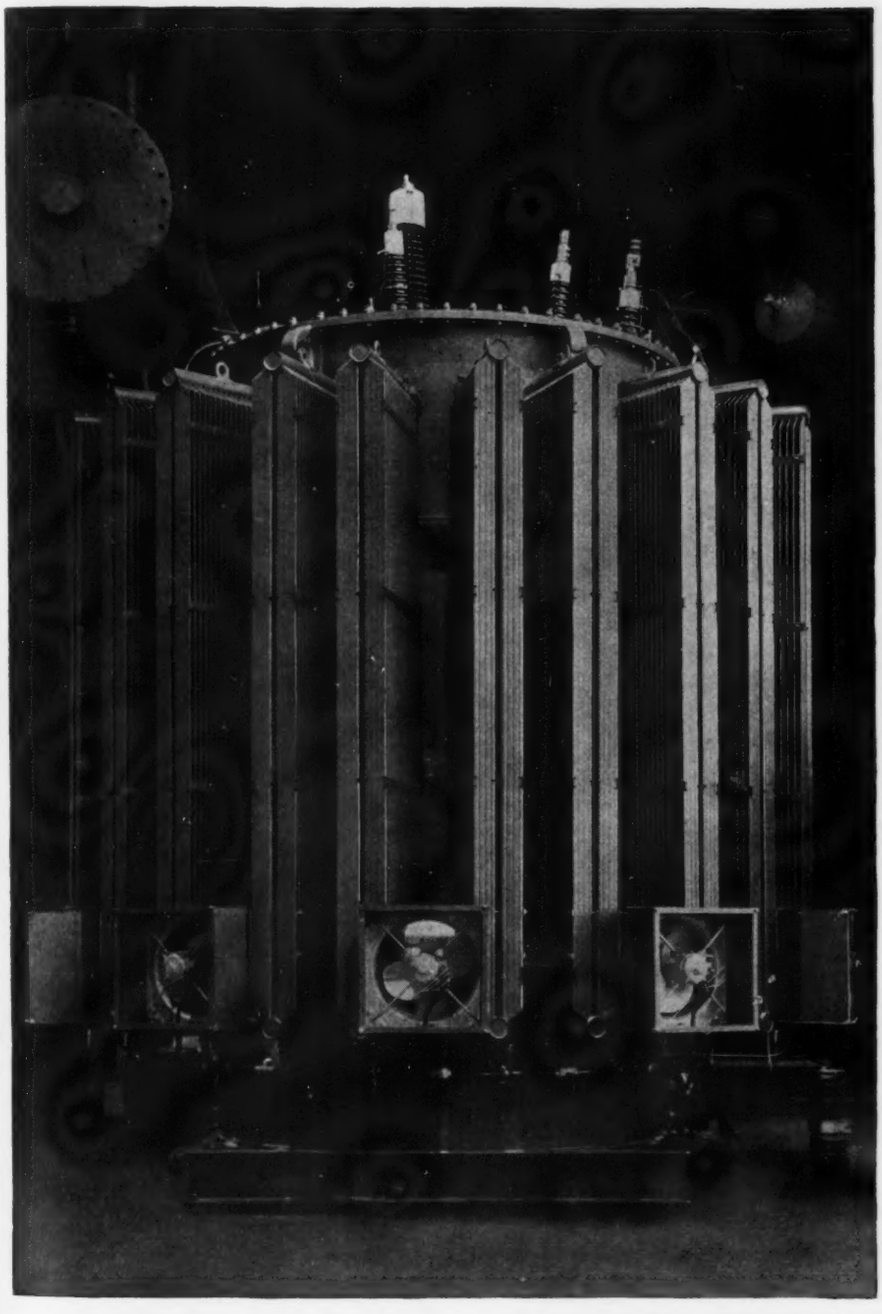
By Irvin Bussing. Published by Columbia University Press, 2960 Broadway, New York. 174 pages, tables. Price, $2.75.

Tracing its history through some 75 years of gas trial in Great Britain, the author shows how modifications were made when the sliding scale was applied to the electrical industry there, where now 178 companies are on "maximum dividend" regulation, 215 on "standard price" (sliding scale) and 21 on the so-called "basic" system as well as the "shareholders' bonus" system devised for electric utilities. Toronto's gas company, the Massachusetts gas and Dallas Power & Light functioning are also surveyed, as well as Connersville, Memphis, Philadelphia, Houston and Detroit before taking the dominant experience in Washington, D. C.

For the Washington Plan the author finds

Of course, it's good!

It's made of good sound steel



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UNITED STATES STEEL

CORE AND COIL ASSEMBLIES OF WAGNER TRANS-FORMERS
Photo F1430 — Typical type HF single-phase transformer element representative of 1.5 to 5 kva., 6900 to 13800-volt ratings.
Photo F1528 — Typical core-type element representative of voltage ratings 16501 to 33000 — standard ratings up to 200 kva. Element shown is a 10 kva., 33000-volt unit.
Photo F1409 — Typical three-phase transformer element. 50 kva., 2300/4000Y to 115/230 volt element shown.
Photo F1278 — Typical shell-type single-phase distribution transformer, representing ratings of 15 to 200 kva. in voltages up to and including 5000 volts. 100 kva. unit shown.
Photo F1411 — Typical shell-type single-phase element, representative of ratings from 250 to 500 kva.

For Wagner transformers from the smallest to the largest, a wide diversity of magnetic structures and methods of assembling them exist. The choice of the type of construction is determined by the various mechanical and electrical factors, the importance of which vary with the rating and dimensions of the transformer, such factors as reliability of insulation, mechanical strength, compactness, relation between width, length and height of each unit, etc. Bulletin 180, which completely describes the construction details, will be sent upon request.

TD336-5B

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

TRANSFORMERS MOTORS FANS BRAKES

statistical support for part of its success in the higher level of economic well-being there at the moment. but some other indexes are found adverse or of little influence. Much detail is incorporated.

Admitting that the sliding scale philosophy of semi-automatic regulation has its imperfections, the author does make a strong brief for its superiority over conventional rate regulation. It is at least automatic for the most controversial components once the initial rate base and rate of return have been fixed.

•

Invitation to Industry

By William A. Rhodes. Published by the Christopher Publishing House, 1140 Columbus Avenue, Boston, Mass. 180 pages. Price, $3.

It is to be regretted that the author did not write the book he conceived. It should have been done. Instead the author here publishes letters to the White House to which were appended many letters to editors (including ELECTRICAL WORLD) discussing a variety of business topics projected into the arena by the depression and the hectic remedies introduced. The many novel but simple theories for advancement of business were referred by the President's office to NRA, Madame Secretary of Labor, etc. "Market Development" "Utility Regulation," "Virgin Islands Radios for T.V.A.," the milk wars, sweatshops are typical samples of topics discussed in from one to ten pages. This unrejoined debate with the Administration bubbles with ideas for ameliorating the dislocations that industry still suffers. A simple exposition is given of the valuelessness of money except as a medium of stimulating trade.

•

Graphical Solutions

By Charles O. Mackey. Published by John Wiley & Sons, 440 Fourth Avenue, New York City. 130 pages, illustrated. Price, $2.50.

Not purporting to be a treatise, this book does, however, give in simple, terse, concise manner the mechanics of making charts and graphical solutions. Preliminaries are minimized to permit quick entrance to sliding scales and rules, followed by network charts, alignment charts (nomograms to others), empiricals and non-periodics. The illustrations are principally from the field of mechanical engineering, thermodynamics and gas chemistry. Mathematical support is curtailed for the sake of multiplied examples of application. A pocket carries Lipka's logarithmic scale chart.

•

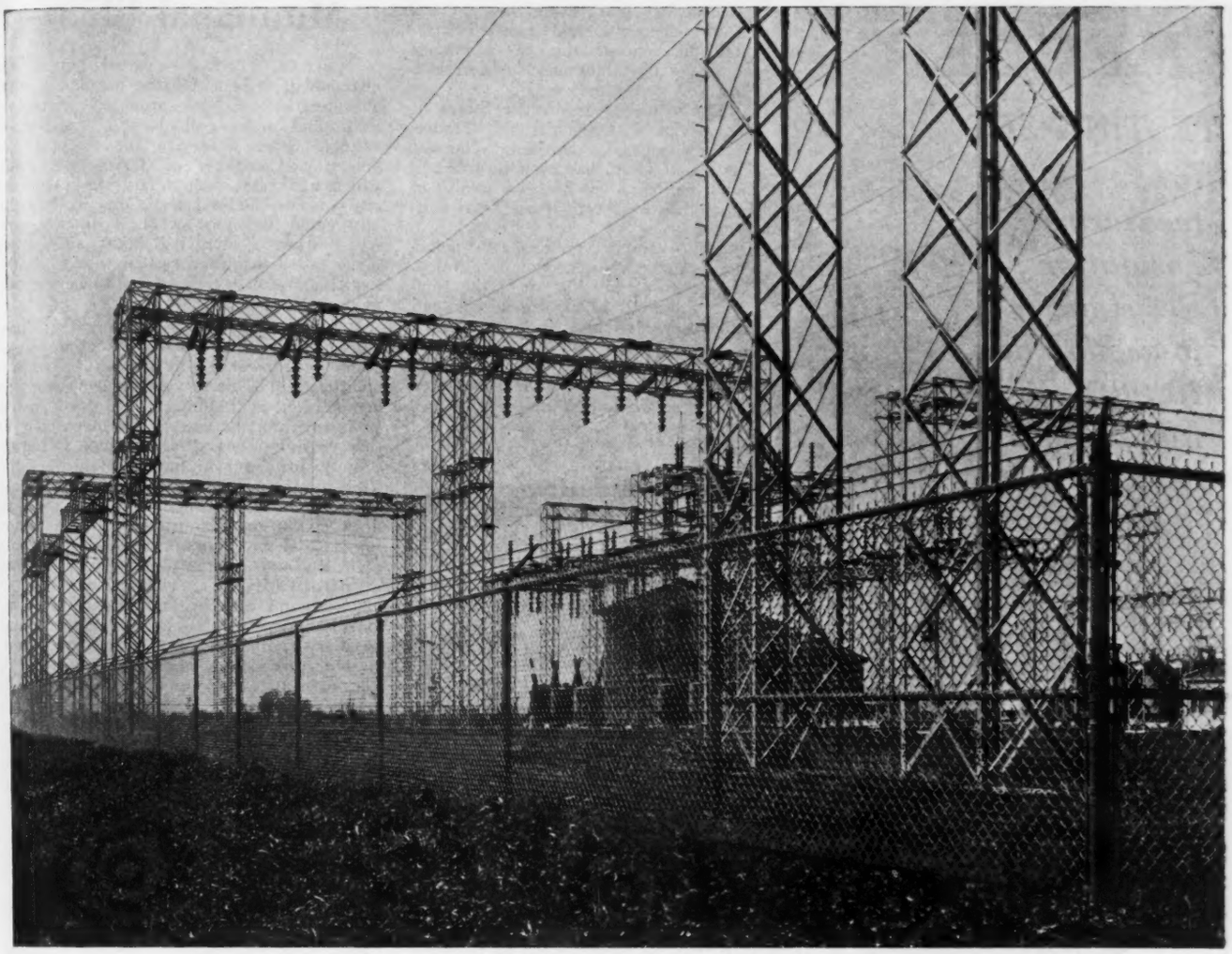
Nel Cinquantentario della Societa Edison

(On the Fiftieth Anniversary of Societa Edison)

Published by Societa Edison, Milan, Italy. 4 volumes totaling 1,930 pages.

This monumental work, which the Societa Edison of Milan, the oldest among electric public utilities of the Continent, and still one of the largest, has published to celebrate its Golden Jubilee, is one of the most comprehensive and thorough attempts made to trace the history of the technical and economical development of the electric power industry. Volume I, entitled "Fifty years evolution of hydraulic structures, prime movers, electric machinery and transmission lines," illustrates the technical evolution of generation and transmission.

The tie that binds the economic aspects



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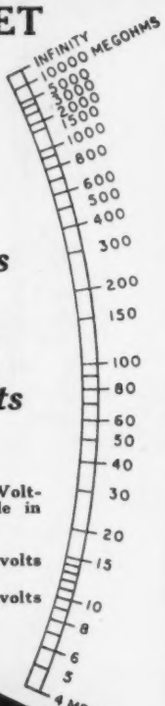
UNITED STATES STEEL

"MEGGER"

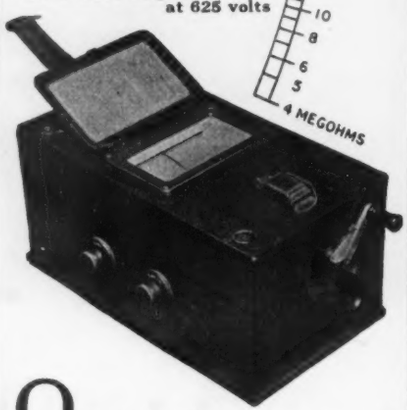
TRADE MARK REGISTERED U.S.PAT. OFF.

TESTING SET

for measuring Insulation Resistance to as high as 10,000 MEGOHMS at 2500 volts



Additional Ranges and Voltages are now available in the same instrument:
1.5 to 5000 megohms at 1250 volts
.25 to 2500 megohms at 625 volts



ONE Utility Company now uses eleven of these high-range "Megger" sets. The instruments are assigned to various company divisions and maintenance crews, and are used for periodic tests of generators, transformers, bushings, insulators and other equipment on which it is safe to apply the 2500 volts d.c., which these sets generate.

By this relatively inexpensive procedure, many defects are detected in advance of failure and much unnecessary trouble is avoided. The company considers these 10,000-megohm "Megger" sets quite superior—especially in high tension work—to lower range "Megger" instruments.

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Other Biddle Specialties:

"Megger" Ground Testers
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"Ducter" Low Resistance Testing Sets
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"Frahm" Vibrating-Reed Tachometers and Frequency Meters
"Jagabi" Rheostats
"Jagabi" Speed-Measuring Instruments

of the electrical market to the physical properties of electric energy, from which results both the concentration of enterprises and the prices for different classes of consumers is well delineated.

Evolution in Italy, the United States of America, Germany, Great Britain, France, Canada, Switzerland, Sweden, Norway, U. S. S. R. and Japan has been recorded in the second and third volumes. A wealth of statistical tables has been drawn from first-hand sources.

The fourth volume contains two monographs, illustrating the economic development of Milan and the history of the company, now operating 149 hydro-electric and 20 steam-power stations, all feeding in a 130-kv. "grid" which totals 1,800 circuit miles of transmission lines and supplies a large part of northern Italy, having an area greater than the whole of Switzerland.

•

Canadian Installations Increase to 7,909,115 Hp.

New hydro-electric installations aggregating 362,080 hp. were completed and made ready for operation in Canada during 1935, thereby bringing the total at the end of the year to 7,909,115 hp. Details are given in an announcement by the Dominion Water Power and Hydrometric Bureau, Ottawa, under the head "Hydro-Electric Progress in Canada, 1935." The figures quoted include plants for manufacturing and mining as well as central stations. Output also increased; for the first nine months it was 11 per cent greater in 1935 than in 1934.

The installations completed and the principal projects planned or under construction may be summarized as follows:

Completed in 1935

Company	New Plants (Hp.)	Additions (Hp.)
Yukon Territory		
Yukon Consolidated Gold Corp., Ltd., North Fork, Klondike River.	.....	5,000
British Columbia		
Bullion Placers, Ltd.	500	.....
Pioneer Gold Mines of B. C., Ltd.	.....	280
Manitoba		
Gods Lake Gold Mining Co., Ltd., Island Lake River	1,900	.....
Ontario		
Hydro-Electric Power Commission Rat Rapids, Albany River	1,200	.....
Canyon, Abitibi River	.....	198,000
Town of Orillia, Gull River	5,200	.....
Quebec		
Beauharnois Light, Heat & Power Co. (Incl. late 1934)	.....	150,000

Projects Planned or Started

British Columbia		
Quesnel Light & Power Co., Ltd.	200	.....
British Columbia Nickel Mines, Ltd., Emory Creek	.....	2,000
Bayonne Consolidated Mines, Ltd., Summit Creek near Tye	375	.....
Ontario		
Hydro-Electric Power Commission, Rat Rapids, Albany River	.....	1,650
Ear Falls, English River	.....	5,000
Quebec		
MacLaren-Quebec Power Co., High Falls, Lievre River	.....	30,000
Norands Power Co., Ottawa River	20,000	.....
Central Quebec Light & Power Co., Ulverton Rapids, St. Francois R.	10,000	.....
New Brunswick		
New Brunswick Elec. Pwr. Com'm Newcastle Creek (steam, kw.)	.....	6,250
Nova Scotia		
Nova Scotia Power Com'n, Ruth Falls, East R. Sheet Harbour	.....	4,300
Annapolis Power & Paper Co., Paradise Brook	3,000	.....

Municipal Plants

FAIRFIELD, IOWA — City Council has abandoned, at least for the present, further consideration of the proposed municipal light and power plant and distribution system. Some time ago the Federal Engineering Company, of Davenport, Iowa, which had made preliminary studies of the city's needs, advised the Council that the city could not get anywhere in the construction of a municipal light and power plant and distribution system with $100,000. For this reason the decision has been made to drop the project.

HOPKINTON, IOWA — Arguing that inasmuch as there had been no approval of plans and specifications prior to advertisement for bids there could have been no competition in bidding, the Iowa Electric Company brought suit at the beginning of this year in the district court of Delaware County, Iowa, for injunction to prevent the town from erecting a municipal electric light plant under the so-called "Simmer Law." In deciding for the plaintiff recently the court found "that the invitation to bidders and the plans and specifications were so far lacking in particularity in the description of the material and articles for which bids were invited, namely, the Diesel engines and auxiliary equipment, as to kind, type, materials of which to be made and constructed, type of construction, quality thereof, and in many other details, as to render competitive bidding impossible. The evidence of the plaintiff, which was wholly unchallenged, points out instance after instance of the plans and specifications lacking any reasonable degree of particularity or definiteness, and in most, if not all, of such instances definiteness and particularity was not only entirely practical but also decidedly in accord with the best practice of engineering. . . ."

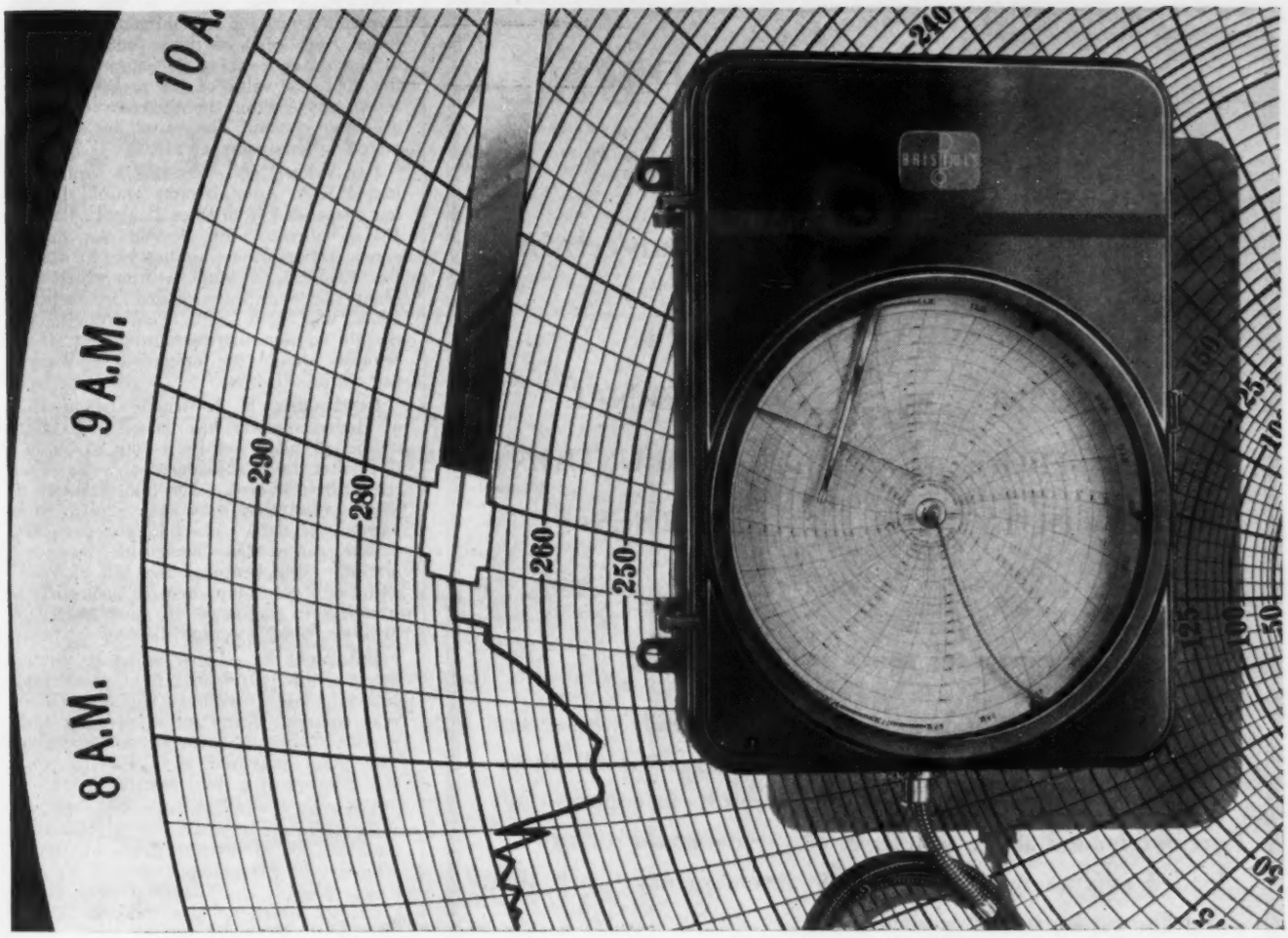
MANCHESTER, IOWA—City has granted a 25-year franchise to the Iowa Electric Company. The vote in favor of the franchise was 586; that against 529.

CALIFORNIA, MO. — Missouri Supreme Court has ordered the Missouri Utilities Company to move its poles, wires and electrical equipment from the streets of the city by October 1. The order resulted from an ouster proceeding against the utility by officials of the city after construction of a municipal electric plant which began operation in December, 1934. The municipal plant was constructed with P.W.A. funds. Judge Charles T. Hays ruled that the right of the utility to use the streets had expired with the franchise in 1929. Inasmuch as there was no bad faith on the part of the company, no fine was assessed.

ST. PAUL, NEB.—Purchase of the electrical distributing system of the Central Power Company has been completed after nearly three years of litigation in the Nebraska courts. The city voted to purchase the system through condemnation proceedings and the district court fixed the price at $42,989. The company appealed to the Supreme Court, but later dismissed the action. The company has accepted a check for the amount stated above for full payment of the system.

BEATRICE, NEB.—Directors of the Southeastern Nebraska Public Power District, with headquarters in this city, has announced that nearly 500 farmers have signed contracts to purchase electrical energy from the district.

STROMSBURG, NEB.—City officials have put into motion the machinery by which they propose to take over the electric plant and distribution system of the Iowa-Nebraska Light & Power Company within its confines.



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WITH THIS Bristol's Recording Thermometer continually watching your processing, fluctuations in temperature *are* always discovered, —in time.

Every variation, even the smallest, is instantly recorded. Is the temperature jumping too high? Too low? Has something gone wrong? The ever-alert Bristol's chart record immediately forewarns you.

Here is an aid to more efficient manufacturing that pays its own way in the information it provides. Accurate within the closest industrial tolerances—of simplified construction free from costly upkeep—sturdily built for assuring good performance.

Write for Bulletin No. 443W. You'll find it interesting and helpful.

AUTOMATIC CONTROL IS MODERN TREND

Many plants today are using instrument control for automatically regulating such process variables as temperature which they formerly were content just to measure. The resulting economies in the way of better product quality are often surprising. Our engineers will welcome the opportunity to discuss the matter with you.

A COMPLETE LINE

Bristol's Thermometers are fully described in our new comprehensive 88 page Thermometer Catalog and Handbook, now on the press. In writing, ask for Catalog No. 1250W.

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PIONEERS IN PROCESS CONTROL SINCE 1889

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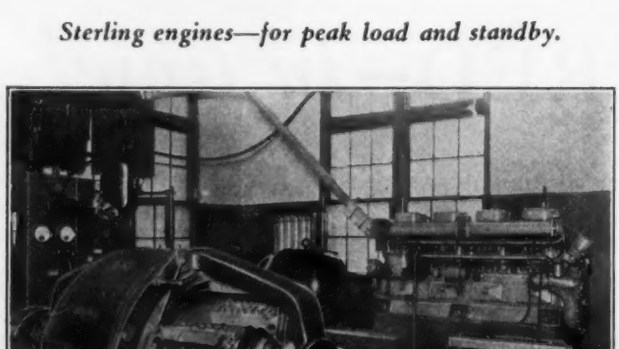
For 14 years Sterling has been advertising

STERLING HIGH DUTY INTERNAL COMBUSTION ENGINES

for emergency power at 1200 R. P. M.

Certain fundamentals in design and materials were originally basic knowledge and have been observed all these years. By contrast, lesser knowledge results in engines that are overloaded above 900 R. P. M. How *could* such overloaded engines serve you reliably, in emergency, when the standby set is the last resort?

Sterling engines—for peak load and standby.



For auxiliary fan drive the Youngstown Sheet & Tube Co., Debue, W. Va., employs a Sterling Dolphin C-8 cylinder 240 H.P. engine direct connected to a 125 KVA. Westinghouse generator, 60 cycle, 2300 volts, 1200 R.P.M.

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Application was made to the Nebraska Supreme Court for appointment of a district judge from each of three judicial districts in the state to sit at Osceola to determine the appraisal value of the property. At the recent city election the citizens voted to take over the system. The value has been estimated by engineers at $43,000.

LAS VEGAS, NEV.—Pending a formal hearing, P.W.A. Administrator Harold L. Ickes has suspended from office James L. Vandiver, P.W.A. director for Nevada, for delaying consideration of an application by the city for $250,000 to build a municipal power plant. The application, filed September 11, 1935, was held until February 4, 1936, despite an administrative order that all such requests should be forwarded to Washington within 30 days.

PAWTUCKET, R. I.—Rhode Island House of Representatives has passed a $5,000,000 municipal plant act by a vote of 56 to 39 to further the establishment of a gas or electric utility, or both. The bill authorizes the sale of electricity from such a plant to any part of the state. The bill next goes to the Senate corporations committee for consideration. Opponents of the bill charged it with being too comprehensive, socialistic and standing in the way of much-needed improvements in sewerage disposal.

BRANDON, VT.—Local agitation to establish a municipal electric light plant has resulted in failure with the signing of a four-year contract with Central Vermont Public Service Corporation for the street lighting. The plant proposed as a P.W.A. project was rejected at a town meeting.

YORKTOWN, TEX.—Taxpayers, by their vote, recently authorized the City Council to issue $65,000 of revenue bonds for the construction of a municipal electric light and power plant. The Central Power & Light Company, which holds a franchise for electric light and power service for Yorktown, expiring 1965, has announced that it will continue to operate in spite of the construction of a municipal competing plant.

•

Recent Rate Changes

HARTFORD ELECTRIC LIGHT COMPANY will reduce commercial power rates, effective June 1, by approximately $300,000 annually. The reduction has been made possible, the company explained, by resumption of improvement in operating returns, which was interrupted by the flood. Directors decided to disregard the non-recurring losses incidental to the flood, and to grant concessions to wholesale users of energy. The immediate saving, it is calculated, will be $200,000, with possibility of adding at least $100.000 more to this saving by customers taking advantage of the new inducement rates for further use.

ARKANSAS UTILITIES COMMISSION has set May 18 for a hearing on proposed new rules and regulations covering all types of service by electric, gas and water utilities. The commission pointed out that if any of the rules worked a hardship on companies they would be given the privilege of applying for modification or exemptions.

MARYLAND LIGHT & POWER COMPANY has made a voluntary reduction in rates to the customers served in southern Maryland. The reduction, effective on all service billed after the April, 1936, meter readings, will total approximately $9,500 a year. The territory in which the reduction in rates is effective includes portions of Prince George's, Charles, Calvert and St. Mary's counties. About 1,200 customers will be affected.

"What are the products in the X-Y-Z line?" a buyer asked—

Use
THE BUYERS
REFERENCE NUMBER
of
ELECTRICAL WORLD
to find out
What to Buy—Where to Buy it
Who Makes it

TRADE NAME INDEX

...le Non-Metallic Conduit, ...mwood), Hartford, Conn.
...etallic Sheathed Cable, ...mwood), Hartford, Conn.
... Molding, Mitchell Mould-...le Ave., Forest Park, Ill.
... Co., 49th & Grays Ave.,

... Corp. of America, New

...imwood) Hartford, Conn.
... 727 Eastham Ave., E.,

... Resistors, Ohmite Mfg. ... Ave., Chicago, Ill.
...reene St., (Germantown)

...sistors, Wirt Co., 5221 ...rmantown) Philadelphia,

...es Washers, Pine-Ihrig ...osh, Wis.
...um Foundry Co., 16th & ...ltowoc, Wis.

WRIGLEY Co., Thomas, 613 W. Lake St., Chicago, Ill.
WRINKLET—Sockets, Bryant Electric Co., 1420 State St., Bridgeport, Conn.
WROUGHT Washer Mfg. Co., 2100 S. Bay St., Milwaukee, Wis.
WT—Cable Lugs, Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.
WUELKER Flexo-Dome Co., 195 Fremont St., cor. Howard, San Francisco, Cal.
WURDACK Electric Mfg. Co., Wm., 4404 Clayton Ave., St. Louis, Mo.
WYCKOFF Pipe & Creosoting Co., 522 Fifth Ave., New York, N. Y.
WYR-WAY—Ornamental Metal Raceway Moulding, Knapp Bros. Mfg. Co., 220 Scott St., Joliet, Ill.
WYZENBECK & Staff, 566 W. Washington Blvd., Chicago, Ill.

—X—

X-CEL-ALL Co., Monaca, Pa.
XDUCT—Steel Conduit, America... Circular Loom Co., 205 ... York,

X-Y-Z—Concentric Cable, Flexible Steel Armored Cable, Flexible Metallic Conduit, Flexible Non-Metallic Conduit, Asbestos Covered, Heavy Duty and Twisted or Parallel Cord, Friction and Rubber Tape, Lead Sheathed and Rubber Covered and Braided Wire. John Doe Mfg. Co., Jonesville, N. Y.

—Y—

YAGERS—Soldering Flux, Benson Co., Alex. R., S. Bay Rd., Hudson, N. Y.
YALE & Towne Mfg. Co., 4530 Tacony Ave., Philadelphia, Pa.
YANKEE—Pocket Ammeters and Voltmeters, Lundquist Tool & Mfg. Co., 57 Jackson St., Worcester, Mass.
YANKEE—Angle and Ratchet Braces, Hand and Breast Drills, Screwdrivers, North Bros. Mfg. Co., American St. & Lehigh Ave., Philadelphia, Pa.
YAXLEY Mfg. Co., 3029 E. Washington St., Indianapolis, Ind.
Y-M—Motor Operated Door Openers, Yoder-Morris Co., 5500 Walworth Ave., Cleveland, Ohio
YODER-MORRIS Co., 5500 Walworth Ave., Cleveland, Ohio
YORK Oil Burner Corp., York, Pa.
YOST Mfg. Co., Meadville, Pa.
YOUNG Bros. Co., 6500 Mack Ave., Detroit Mich.
YOUNG Co., A. B., Fair Haven, Vt.
YOUNG & Franklin Tool Works, 107 N. Franklin St., Syracuse, N. Y.
YOUNGSTOWN ...

He had the whole story in one minute!

Thanks to the Buyers Reference Number of Electrical World, it's a simple matter to locate a given product when only the trade name is known.

The trade and company name index immediately locates the manufacturer. Reference to the classified directory gives further details with more specific data on the product . . . and in many cases, a complete catalog of this manufacturer will be found in the products exhibit section.

Keep this book handy in making up specifications and planning future buying. It will save time and simplify your work.

ELECTRICAL WORLD
330 West 42nd St., New York, N. Y.

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BUYERS REFERENCE NUMBER
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—to save time and money in your buying

Yesterday

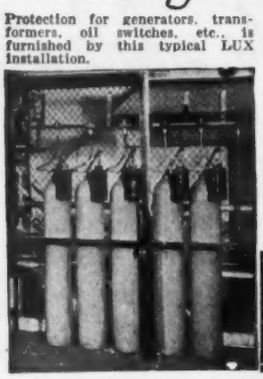
FIRES TAXED MAN POWER TO LIMITS OF ENDURANCE

An old-time fire in New York meant a strenuous time for the fire-fighters. Other interesting illustrations, taken from old prints, will appear in advertising of LUX Fire Protection in future issues of this publication.

Today

FIRES ARE EXTINGUISHED WITHOUT HUMAN HANDS

Protection for generators, transformers, oil switches, etc., is furnished by this typical LUX installation.



● Consider the advantages of Lux automatic fire system as described by a large utility.

A southern substation burned to the ground—Town without power for three days. Rebuilt and Lux equipped—Struck by lightning—while unattended, causing fire in instrument transformer and oil switch, yet report shows that not a light went out and repair bill negligible.

Let Lux engineers survey your power plants and submit concrete recommendations.

Walter Kidde & Company, Bloomfield, N. J.

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- TELEPHONE CABLE
- BARE COPPER WIRE AND CABLE
- WEATHERPROOF WIRE AND CABLE
- MAGNET WIRE
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"QUALITY ABOVE SPECIFICATIONS"

WEATHERPROOF CABLE

KENNECOTT WIRE AND CABLE COMPANY
PHILLIPSDALE, RHODE ISLAND
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AMERICAN ELECTRICAL WORKS
FORMERLY
NEW YORK, 100 E. 42nd STREET
CHICAGO, 20 NORTH WACKER DRIVE
CINCINNATI, TRACTION BUILDING

SALES OPPORTUNITIES IN NEW CONSTRUCTION

LAWTON, OKLA. — Has engaged W. R. Holway, New Wright Building, Tulsa, Okla., consulting engineer, to make surveys and estimates of cost for new city-owned electric power plant.

DOSWELL, VA. — Farmers' Rural Utilities, Inc., Bowling Green, Va., plans transmission and distributing lines in vicinity of Doswell, Hanover County, for rural electrification, totaling about 65 miles, with service facilities.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, receives bids until May 13 for standard frequency control equipment and accessories for Norris, Wheeler and Wilson hydroelectric power plants.

NORTH CANTON, OHIO—Hoover Company plans installation of motors and controls, conveyors, etc., in new addition to vacuum cleaner manufacturing plant. Cost about $100,000.

BELLEFONTAINE, OHIO—Logan County Co-operative Power & Light Association, E. G. Denmead, president, plans transmission and distributing lines for rural electrification in Logan County, including service facilities, and soon takes bids for equipment. Cost over $200,000. Financing is being arranged through Federal aid.

RICHLAND CENTER, WIS.—Plans extensions in municipal electric power plant, including installation of new 1,000-kw. turbo-generator unit and auxiliary equipment.

GRAND RAPIDS, MICH.—Grand Rapids Varnish Corporation, Steele Avenue, plans installation of motors and controls, conveyors, electric hoists and other equipment in new additions to plant. Cost over $600,000. Harry L. Mead, Grand Rapids, is architect.

PORTLAND, ORE.—United States Engineer Office, Pittock Block, receives bids until May 13 for 54 street-lighting standards (Circular 348).

AITKIN, MINN. — Aitkin County Rural Co-operative Company, recently organized, is arranging financing for new transmission and distributing lines for rural electrification in different parts of Aitkin County, totaling about 90 miles, with power substation and service facilities. Cost $100,000. Bonds authorized. George Boyer and A. W. Hoffman are in charge.

ALBANY, GA. — Cudahy Packing Company, 221 North La Salle Street, Chicago, Ill., plans installation of motors and controls, conveyors, electric hoists, transformers and accessories, and other equipment in new multi-unit meat processing and packing plant at East Albany, where large tract of land has been secured. A power house will be built. Cost close to $400,000.

SALISBURY, MD. — Eastern Shore Public Service Company is arranging fund of about $700,000 for extensions and improvements during 1936, including power plants and equipment installations, transmission and distributing lines for rural electrification and other expansion, power substations and miscellaneous work.

NITRO, W. VA.—Viscose Company, 200 Madison Avenue, New York, N. Y., plans installation of motors and controls, regulators, conveyors, etc., in new acetate rayon yarn mill at Nitro. Cost close to $250,000.

HILLSBORO, OHIO—Inter-County Rural Electrification Co-operative Association, Hillsboro, J. E. Garretson, manager, plans transmission and distributing lines for rural electrification at Hillsboro, Wilmington and vicinity, totaling over 100 miles. A new power plant is under consideration. Entire

project is reported to cost close to $200,000. Financing will be arranged through Federal aid.

BROOKLYN, N. Y.—Signal Corps Procurement District, Army Base, Fifty-eighth Street and First Avenue, receives bids until May 25 for 64,600 feet paper-insulated telephone cable and 32 reels (Circular 205); also, until May 29 for quantity of portable field telephones in lots of 700 to 1,599 (Circular 195).

RED OAK, IOWA—Iowa-Nebraska Light & Power Company, Lincoln, Neb., has approved plans for new addition to steam-electric generating plant at Red Oak. Cost about $250,000 with equipment.

CLIMAX, COLO.—Climax Molybdenum Company, 500 Fifth Avenue, New York, N. Y., plans installation of motors and controls, conveyors, electric hoists, loaders and other equipment for expansion and improvements in mining plant at Climax. Extensions will be made in power house, with installation of additional equipment. Entire project will cost about $350,000. G. M. Musick, Republic Building, Denver, Colo., is architect.

THAYER, MO.—Receives bids until May 14 for new city-owned electric power plant and equipment. Fund of $72,000 has been arranged. W. A. Fuller Company, 2916 Shenandoah Avenue, St. Louis, Mo., is consulting engineer.

BEATRICE, NEB.—Southeastern Nebraska Public Power District, Beatrice, L. C. Black, engineer, in charge, has plans nearing completion for transmission and distributing lines in six townships in Northern part of Gage County for rural electrification, and will soon take bids for equipment, including service facilities. Entire project will total over 400 miles. Cost close to $450,000. Financing has been arranged through Federal aid.

NEWARK, N. J.—Board of Education, 31 Green Street, receives bids until May 13 for generators, motors, transformers, rheostats, electrical instruments and other electrical supplies; also for electric time clocks, parts, etc. Alfred H. Krick is secretary.

MARSHALL, MO.—State Building Commission, Capitol Building, Jefferson City, Mo., Edgar M. Eagan, executive secretary, receives bids until May 12 for extensions and improvements in power plant at institution at Marshall, including one 375 kva. and 250 kva., engine-generator units and auxiliary equipment. Fund of $229,000 has been authorized for entire project. J. H. Porter & Company and George E. Wells, Inc., both Security Building, St. Louis, Mo., are consulting engineers; Charles A. Haskins, Finance Building, Kansas City, Mo., is supervising engineer.

MONTREAL, QUE.—Consolidated Mining & Smelting Company of Canada, Ltd., Montreal, plans installation of heavy-duty motors and controls, conveyors, electric hoists, loaders and other equipment in new milling plant at gold-mining properties. Cost close to $250,000.

WASHINGTON, D. C.—Bureau of Supplies and Accounts, Navy Department, Washington, receives bids until May 19 for quantity of knife-type enclosed switches and spare parts for Eastern and Western Navy Yards (Schedule 7822).

MINOT, N. D.—Northern States Power Company, Minneapolis, Minn., has approved plans for extensions and improvements in steam-electric power plant at Minot, and will proceed with project at once. Additional equipment will be installed. Cost close to $100,000.

WASHINGTON, D. C.—United States Engineer Office, Navy Building, receives bids until May 12 for two 100-kva. distribution transformers with accessories.

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The Original Glass Cleaner

Every pound of Skybryte 2-x Crystals makes three gallons of the *original* chemical glass cleaner. Skybryte may be used either as a dipping bath or with a sponge. The most stubborn dirt and grime are completely dissolved leaving a clean sparkling surface.

The use of 2-x Crystals has many advantages over the use of solutions bought in liquid form. (1) The cost of the material is less (2) the freight charges are lower (3) there can be no loss or damage due to leakage and (4) the solution can be mixed right on the job.

For 20 years Skybryte has been sold on a guaranteed money-back basis and for 20 years has been the leading brand of chemical glass cleaner. Such success can only come from satisfied customers.

If you are not already using Skybryte to clean your globes, reflectors and insulators, find out now how you can do the job in less time and at less cost than your present method. If you are not *completely* satisfied with the performance of Skybryte the test will cost you nothing. We will ship your initial order freight prepaid and stand or fall on the results.

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250 lbs.	40c per pound
100 lbs.	50c per pound
50 lbs.	55c per pound
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Also manufacturers of Rust-tox, the proven material for painting rusted metal without removing the rust.

News Flashes . . . from

McGRAW-HILL EDITORS SEE NEW PROFIT OPPORTUNITIES IN CAPITAL GOODS MARKETS

Materials and Equipment Sales Trend Upwards as Production of Durable Goods Speeds Up

First Quarter Figures Impressive

Heralding the upturn in the capital goods industries, practically all business barometers show substantial gains. Industry's 12 Major Markets are rebuilding and expanding on a broad front. Recent disastrous floods in several of the busiest industrial areas have greatly accentuated the demand for new equipment, machinery and maintenance supplies.

These pages present some of the outstanding facts and figures on the opportunities ahead in five of Industry's 12 Major Markets. They lead to the inevitable conclusion that 1936 offers unprecedented sales opportunities to manufacturers of cost-cutting, profit-producing materials, machines and services.

METAL WORKING

K. H. CONDIT
Editor
American Machinist

65% of the metal-working machinery of this industry is over 10 years old. In other words . . . . obsoletel And the Industry knows it!

This startling figure, developed by *American Machinist's* 1935 Inventory, clearly shows how five depression years have dammed up the normal flow of capital into new and improved machinery.

Since the remarkably successful Machine Tool Show last fall, many equipment manufacturers have been working double shifts, some even three shifts. Domestic sales of machine tools are now reported to be running at the highest levels since 1929. And there is every reason to believe that the replacement of obsolete machines will be accelerated in the coming months.

In the first place, improvement in the durable goods industries, long over-due, is getting under way at a gradually increasing rate. This means expansion of plants, retooling, and the purchase of an increasing volume of accessories and supplies. Second, Social Security legislation gives an added incentive to install the most efficient cost-cutting equipment on the market. Next, because of the unsettled conditions in international affairs, there is a growing interest in National Defense. This will probably involve increasing orders for military, naval and aeronautical equipment. Finally, practically every automobile manufacturer has designs on the drafting boards for a rear-engine job, a coming development which will mean extensive re-tooling of the automotive industry when the time is considered ripe to release this particular innovation to the consumer market.

The metal-working industry as a whole is keenly alive to the profit possibilities that lie ahead in the coming years of business recovery. *This industry is intensely interested in modernizing, from the practical self-interest standpoint of business profits. It will respond, with orders, to sales appeals based on the clean-cut presentation of the benefits to be gained by replacing obsolete machines with modern ones.*

ELECTRICAL INDUSTRY

L. W. W. MORROW
Editor
Electrical World

All branches of the electrical industry are enjoying increased sales this year and this up-turn is expected to continue. *Electrical manufacturers expect a 21 percent increase over 1935, equivalent to a turn-over of more than $3,000,000,000.*

The popularity of electricity and electrical products in the home and farm is causing an unprecedented increase in sales of wiring, appliances and distribution equipment. A revival of industrial plant expansion and modernization, especially in the steel, metal-working and chemical industries has brought large orders for heavy electrical equipment. Utility load growth in all classes of service is causing a large increase in utility buying of generating capacity and distribution apparatus. It is expected that the revival of building activities will bring more business this summer. In addition, government power projects and naval building have increased business.

Despite the enormous use of electricity and electrical products in this country the markets are far from saturated. Nearly 6,000,000 radio sets and 2,000,000 electric refrigerators will be sold in 1936 despite many previous years of selling. Electric ranges are now gaining in favor and a large increase in range business is expected this year.

Utility capital expenditures for 1936 are estimated to be $371,000,000 as against $237,000,000 in 1935. They will order new station capacity of about 1,000,000 kw. in steam turbo-generators to serve the large load increases they are now experiencing and will make many additions and extensions to existing facilities.

The electrical market is enormous with 21,200,000 homes, 3,770,000 commercial establishments, and 364,000 wholesale and industrial users. With such a favorable public and economic acceptance of electrical products and services and such large markets, the electrical industry is optimistic about its future. This opinion is reflected in investment and financial circles to give the industry a favorable credit position. With favorable and stable price levels the industry looks to a year of profitable business with a large increase in volume.

PROCESS INDUSTRIES

S. D. KIRKPATRICK
Editor
"Chem. & Met."

New products and processes are emerging in a veritable flood from the research laboratories of the process industries. Significantly, more of these are going into large-scale production than at any time since 1930, despite the fact that this group of manufacturing industries showed a remarkable record of activity all during the depression.

This transition of processes from laboratory to plant is calling for heavy expenditures for capital goods. *Construction of new chemical plants will run at least 35% ahead of last year's figure of over $75 millions, according to a recent analysis of projects.* New plants obviously call for tremendous capital investments.

Cheaper raw material sources are opening up vast markets for new plastics, synthetic resins, refrigerants for air conditioning, volatile solvents, insecticides and fungicides—many of which were formerly derived from vegetable or other natural sources. Ethyl alcohol, acetone and acetic anhydride—all standard chemicals of commerce—are being produced from petroleum gases which were formerly wasted or used only for fuel. The technology of paint and varnish, turned upside down 10 years ago by the advent of quick-drying lacquers, is again experiencing vital changes as the result of new synthetic resins, pigments and emulsions that improve quality and reduce costs.

The gospel of the research laboratory—more goods at lower prices—is being practiced as well as preached in the process industries. Inherent flexibility in technology, diversity of products and markets, and aggressive, resourceful management have combined to give this group of manufacturing industries an envi-

the Industrial Sales Front

able record of past performance and a sound basis for future growth and development.

FOOD INDUSTRIES

L. V. BURTON
Editor
Food Industries

A food plant is nothing but the enlarged shadow of the old homestead kitchen. Instead of feeding a family of ten it feeds a family of tens of thousands. If one will just remember this rather homely fact it will be difficult to envision anything but a rosy future for the food industries. The tendency is greater than ever to help the lady of the house spend fewer and easier hours in her kitchen.

With commodity prices rising—food manufacturers cannot look forward to any great relief from high manufacturing costs except through the use of cost-reducing machinery and equipment. Self-preservation demands that selling prices be kept as low as possible to avoid shifts of consumer demand. Inside food plants the adoption of air conditioning, electric refrigeration and improved ventilation systems is causing radical changes in manufacturing operations. *Manufacturers who can show how their equipment will reduce the costs of handling, storing, processing or packaging food products can be assured of a responsive market.*

Another reason for anticipating increased buying is this: When the consumer tightened his belt, the food industries tightened up on its maintenance program. But it is impossible to operate a worn out plant on the narrow profit margins in the food business, so the first sign of reviving consumer income has resulted in increased maintenance and renewal programs. We estimate that there still is a 5-year backlog of replacement program in the food industries. *As the first quarter closed, 1936 purchases of new equipment, in the food industries, were estimated at $125 to $150 millions, a 20% to 35% increase over the very satisfactory showing made by these industries in 1935.*

TEXTILE INDUSTRY

D. G. WOOLF
Editor
Textile World

Purchases of machinery and equipment by textile manufacturers in 1935 were approximately $80,000,000 and trending steadily upward. That this sales volume, still below 1929, will continue to accelerate is indicated in several ways. For instance, sales during the last half of 1935 were considerably ahead of the first half. 1936 opened strong and demand is still moving upward.

This expanding market is a direct result of the marked technological development of recent years. Particularly in the past five years, improvements in equipment have come so rapidly as to make obsolete even those new plants of the post-war expansion period. Practically all equipment purchases have been for modernization purposes.

Textile manufacturers are becoming more profit minded and are keenly aware that continued profits must come from modernization of equipment. Food and clothes are basic to life—both respond sensitively to increased purchasing power in the hands of consumers. From every viewpoint, the textile industry represents a fertile field that will continue to improve for the manufacturer of equipment and supplies that will cut costs and increase profits.

Advertising—the mass production sales tool—can help you win a greater share of the orders now being placed in Industry's 12 Major Markets. With advertising you can accomplish many of the necessary steps to increased sales, faster and more economically. Advertising—in the right media—calls on all the worth-while buyers in each field, calls regularly and at the lowest cost per call.

A McGraw-Hill representative will be glad to bring you a copy of our book "The Mass Production of Sales" and give you specific information on the sales opportunities in the fields you sell. He can also furnish you with information and data from the McGraw-Hill survey of the industrial losses in the recent floods, and the unexpected sales opportunity created thereby.

Reprints of this advertisement are available and will be mailed on request. Perhaps your salesmen can use them to help sell more equipment to business and industrial companies.

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Made of high strength bronze, with uniformly machined threads and fine workmanship, giving maximum efficiency.

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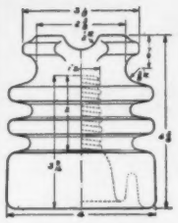

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Built in ¾ to 6 ton capacities—weighing from 14 to 16 pounds.

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LINEMENS RUBBER PROTECTIVE EQUIPMENT

Has merited the confidence of linemen everywhere. It is dependable and is easy to use

W. H. SALISBURY & CO. Inc.
ESTABLISHED 1855
401-421 N. MORGAN ST., CHICAGO

Simplex Jacks
have proved through
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that their design, materials and construction justify
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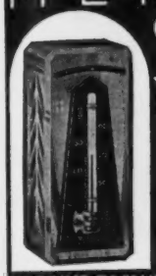

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NATIONAL DOUBLE TUBE SLEEVES

Speed and ease in making line joints—tightness of joints—uniformity of all splices—exactness of size of sleeves—saving of time and energy of men working, under normal or adverse conditions—are all reasons why National Sleeves are the best method of doing your splicing jobs.

Ask your Graybar man for detailed information.

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THE NATIONAL TELEPHONE SUPPLY CO.

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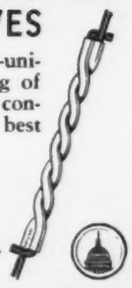

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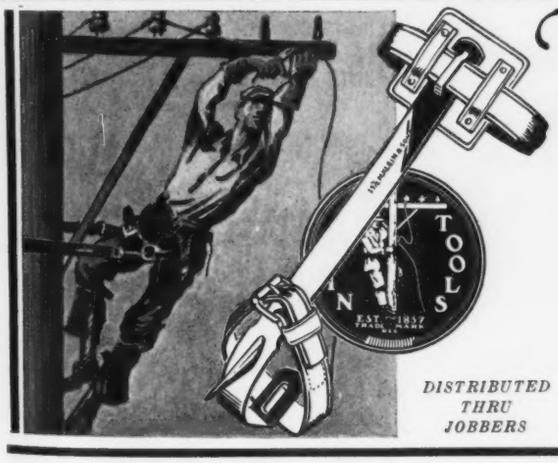

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This book discusses clearly and concisely important legal and ethical principles which are vitally necessary to the engineer's security and success in his business relations with other engineers, his superiors, employees and colleagues, and with the public at large.

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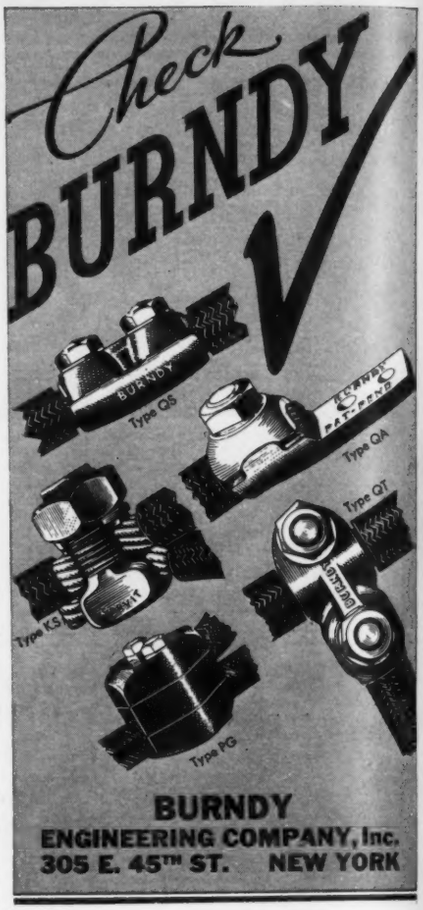

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